Serial No._____

10E8

INSTRUCTION MANUAL

MODEL 2000
SWEEP/SIGNAL
GENERATOR

WAVETEK® INDIANA INC.

66 N. 1ST AVENUE, P.O. BOX 190

BEECH GROVE, INDIANA 46107

317—783-3221

WARRANTY

All Wavetek instruments are warranteed against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use during this period. Transfermatic Switch assemblies, manufactured by Wavetek, are unconditionally warranteed for the life of the instrument. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

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SCHEMATICS AND PARTS LIST

CHANGE INFORMATION, IF ANY, IS LOCATED AT THE REAR OF THIS MANUAL

FIGURE i – MODEL 2000 SWEEP/SIGNAL GENERATOR

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of the WAVETEK Model 2000 Sweep/Signal Generator.

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Wavetek Model 2000 is a compact, sweep and marker generator. It covers the frequency range of from 1.0 to 1400 MHz in 3 overlapping bands.

Since the majority of circuits are contained in plug-in modules, maintenance problems can be greatly simplified by stocking several modules instead of hundreds of discrete components. Servicing time of a defective instrument can be cut to a fraction of the time previously required and can be performed by relatively inexperienced technicians.

This plug-in modular concept also enables the instrument to be economically updated to meet future requirements.

A Rear Panel connector permits remote programming of center frequency, sweep width and output level, plus, external amplitude and frequency modulation.

1.2 SPECIFICATIONS

TABLE 1-1. SPECIFICATIONS

RF SPECIFICATIONS	
Frequency Range-	1 to 1400 MHz in three overlapping bands 1 to 500 MHz 450 to 950 MHz 900 to 1400 MHz
Operating Modes-	Sweep and CW
Frequency Dial Calibration-	10 MHz intervals
Accuracy-	10 MHz or 2% of selected frequency which ever is greater
Vernier Frequency Control-	±5 MHz
Sweep Width-	200 kHz to 500 MHz
Display Linearity-	2%
Spurious Signals-	At least 26dBm below the output from 10 to 1400 MHz
Residual FM -	Less than 15 kHz
Drift -	100 kHz/5 minutes-2MHz/8 hours (after 1/2 hour warm-up at a constant ambient, and allowing a 5 minute stabilizing period after a frequency change)
Blanking -	Retrace blanking of the RF output provided for sweep operation. Removed for CW operation.

TABLE 1-1. Specifications (Con't.)

RF Output - Continuously adjustable from +10 to -80dBm
70dB in 10dB steps
20dB vernier - calibrated in 1dB steps

ACCURACY OF 70dB STEP ATTENUATOR	ACCURACY OF 20dB VERNIER ATTENUATOR
±0.5dB to 500 MHz	±0.5dB to 500 MHz
±1dB to 1000 MHz	±1dB to 1000 MHz
±2dB to 1400 MHz	±2dB to 1400 MHz

Flatness at +10dBm - ±0.5dB from 1 to 1400 MHz when read with a negative detector.
±0.75dB from 20 to 1400 MHz when read with RF power meter.

Output Impedance - 50 ohms
75 ohms optional: Two specifications are involved when changing to a 75 ohm impedance, accuracy of the 70dB step attenuator and the flatness specification. Identical performance is guaranteed up to 1000 MHz with little if any variation to 1400 MHz.

For 75 ohm instruments, the output controls are calibrated in dBmV (0dB reference is 1 mV). Maximum output is +57dBmV.

REMOTE PROGRAMMING

A Rear Panel REMOTE Jack provides necessary connections for Remote Control of Frequency, Sweep Width and the 0 to 20dB Vernier output control. This jack also provides connections for EXTERNAL Amplitude and Frequency Modulation.

Frequency - May be remotely programmed by a ±16 volt signal (-16 volts corresponds to LOW frequency band end and +16 volts to HIGH frequency band end).

Sweep Width - May be controlled by a remote potentiometer. (Input and output connections provided in Rear Panel REMOTE Jack.)

Vernier 0-20dB Output - May be remotely programmed over a 20dB range with a 0 to -18 volt signal (-18 volts corresponds to maximum output).

External FM - The full frequency range can be swept at rates up to 4 kHz. With reduced Deviation and Linearity, modulation rates to 100 kHz are possible.

TABLE 1-1. Specifications (Con't.)

External AM -	External AM signals are applied to the same connections as for vernier 0-20dB control. Therefore, vernier range must be restricted so the 0 to -18 volt range is not exceeded or distortion will occur. With average voltage set to mid-range, 100% modulation is obtainable up to 1 kHz, 40% modulation is obtainable up to a 40 kHz rate.
SWEEP SPECIFICATIONS	
Sweep Modes -	Repetitive sweep Single sweep Externally triggered sweep Manual sweep Line-lock sweep
Sweep Time -	Continuously variable from less than 10ms to over 100 seconds, in 4-decade steps, plus vernier.
Horizontal Output -	16 volts peak-to-peak (symmetrical about ground)
EXTERNAL LEVELING	
External Monitor (ALC) -	An external negative signal, between 0.2 and 2 volts, may be used to level the RF output. The ALC Front Panel input jack mates with Switchcraft type 750 plug.
MARKER SPECIFICATIONS	
Type -	Birdy by-pass markers with provisions for 6 plug-in marker modules, plus, Rear Panel external marker input. Markers may be either single frequency or harmonic (comb.) type. (See Options A-1 and A-2)
Accuracy -	0.005%
External Marker Input -	Rear Panel BNC connector accepts external CW signal for conversion to a Birdy marker. Input level: 100mV into 50 ohms.
Marker Width -	Adjustable from (approx) 15 to 400 kHz in four steps.
Marker Size -	Adjustable from (approx) 1V to 1mV peak-to-peak.
Rectified Birdy -	Internal switch removes the negative portion of the birdy marker for use with X-Y recorders. Size varies with detector's impedance. Adjustable from (approx) 6 volts to 1mV with detector impedance of 1 meg ohm, or from 0.5V to 1mV with detector impedance of 0 ohms.
Marker Tilt -	Provides horizontal markers with a size equal to appromiately 10% of horizontal display. Adjustment of marker size vectorily adds the normal vertical marker

TABLE 1-1. Specifications (Con't.)

to the horizontal marker, causing the resulting marker to vary from a horizontal position toward a vertical position.

POWER REQUIREMENTS
Line Supply 115 or 230 VAC ±10%, 50 to 60 Hz,(approx 20 watts)

MECHANICAL SPECIFICATIONS (See Figure 1-1.)
A For total length, including knobs, add 11/16 inch

B For total height, including feet, add 5/8 inch

C For total width, including screw heads, add 3/16 inch

Weight
Net - 20 lbs.
Shipping - 25 lbs.

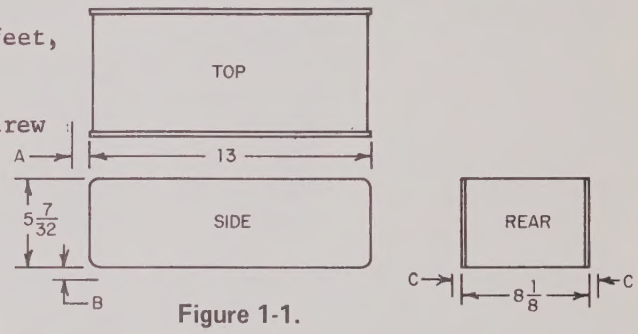


Figure 1-1.

1.3 OPTIONS

1.3.1 Marker A-1. Any single frequency between 1 to 1400 MHz.
1.3.2 Marker A-2. Harmonic type at 1, 10 or 50 MHz. (Other frequencies available on special order.)
1.3.3 Modulator A-4. Provides 100% amplitude modulation at a 1 kHz rate.
1.3.4 Pen-lift A-5. Provides contact closure during sweep time.

1.4 ACCESSORIES

1.4.1 Accessories furnished: Instruction Manual and Plug to mate with Rear Panel REMOTE jack.
1.4.2 Accessories available:

Wide Band RF Detectors

Model D151 for 50 ohm applications up to 1000 MHz.
Model D152 for 50 ohm applications up to 1400 MHz.
Model D171 for 75 ohm applications up to 1000 MHz.

Service Kits

K102. Contains a module extender and extension cable.

19 Inch Rack Mounting Kits

K103. Mounts single instruments in a 5-1/4 inch space. (See Figure 2-1.)
K104. Mounts one or two instruments in a 7 inch space. (See Figure 2-2.)

SECTION 2
INSTALLATION

2.1 MECHANICAL INSTALLATION

2.1.1 Initial Inspection

After unpacking the instrument, visually inspect the external parts for damage to knobs, connectors, surface areas, etc. The shipping container and packing material should be saved in case it is necessary to reship the unit.

2.1.2 Damage Claims

If the instrument is received mechanically damaged in transit, notify the carrier and either the nearest Wavetek area representative or the factory in Indiana. Retain the shipping carton and packing material for the carrier's inspection.

The local representative, or the factory, will immediately arrange for either the replacement or repair of your instrument, without waiting for damage claim settlements.

2.1.3 Rack Mounting

The instrument is 1/2 rack size and two rack mounting kits are available. The K-103 kit provides the necessary hardware to mount the unit to either the right or left of a standard 5¼" x 19" opening. The K-104 kit provides the necessary hardware to rack mount two instruments. These may be two 1000 or 2000 series Wavetek, Indiana Instruments, or two 130 or 140 series Wavetek, San Diego Instruments, or a combination of either. This provides a 7" x 19" package. Facilities are provided for Front Panel mounting of instrument Rear Panel connectors.

2.1.4 K-103, Rack Mounting Kit (Refer to Figure 2-1)

CONTENTS

Item	Qty.	Part No.
A (Side)	1 ea.	B000-608
B (Side)	1 ea.	C000-610
C (Screw)	8 ea.	HS101-806

Procedure:

Remove the screws from one side panel at a time. Mount item A or B against the side panel of the instrument and secure with screws provided (item C). Repeat operation for other side. NOTE: Items A & B may be interchanged to position the unit to the side of the rack desired.

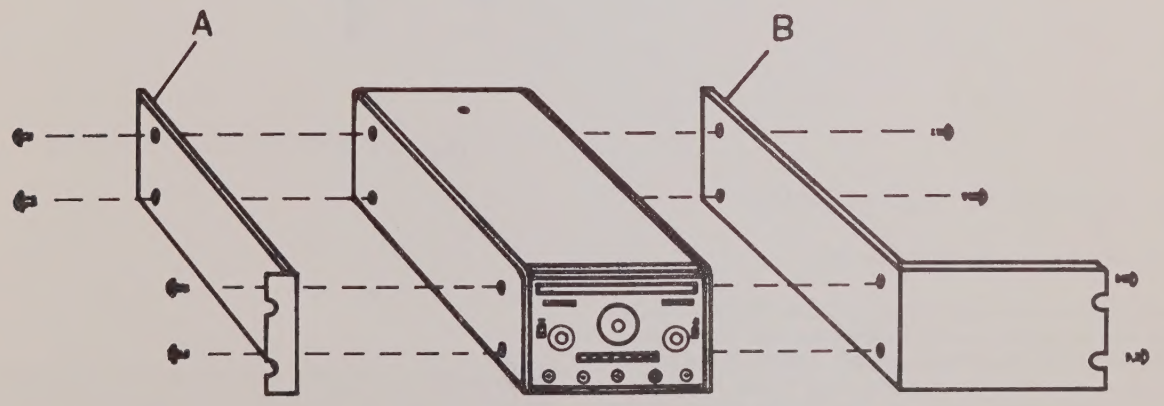


Figure 2-1. K-103 Rack Mounting

2.1.5 K-104 Rack Mounting Kit (Refer to Figure 2-2)

CONTENTS

Item	Qty.	Part No.
A (Tray)	2 ea.	C000-729
B (Side)	2 ea.	A500-230
C (Screw)	12 ea.	HS101-903

Procedure:

Install both sides (item B) to one tray (item A) using 10-32 x 3/16" screws (item C). Position the instrument on the tray so that the feet extend into the provided holes. Holes are provided for all Wavetek, Indiana 1000 and 2000 series and for most Wavetek, San Diego 130, 140, and 700 series instruments. Other instruments not exceeding 5¼" x 8" may also be mounted by drilling additional holes for their feet.

When one or both instruments are properly seated, install the other item "A" and secure with the remaining screws (item C).

NOTE: If the Wavetek instrument has been supplied with a bail, it must be removed before installing in the K-104 rack mounting kit.

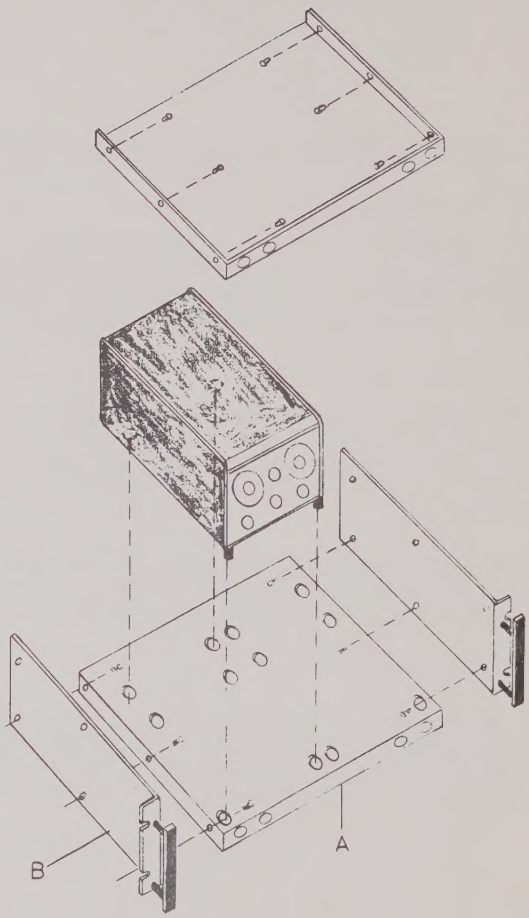


Figure 2-2. K-104 Rack Mounting

2.2 ELECTRICAL INSTALLATION

2.2.1 Primary Power Requirements

These instruments operate from either 115 volt AC or 230 volt AC supply mains as selected by a Slide Switch located on the Rear Panel. Before operating the instrument, check that the fuse mounted in the Rear Panel Fuse Holder corresponds to the correct value for the selected voltage; i.e., 0.5 amp for a 115 volt AC, and 0.25 amp for 230 volt AC.

The power supply has been designed to operate from either 50 or 60 Hz supply mains, however, the line operated sweep rate function must be adjusted to the line frequency.

Instruments are shipped from the factory for operation at 115 volt AC, 60 Hz unless specified for 230 volt AC or 50 Hz operation.

2.2.2 Performance Checks

The electrical performance of this instrument should be verified. Performance checks for incoming inspection are given in Section 5, Maintenance.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides complete functional control description, operating instructions, and programming instructions for the Sweep/Signal Generators. In addition, special operating notes cover sweep rate errors, overloading, low-level measurements and operation with networks analyzers and X-Y plotters.

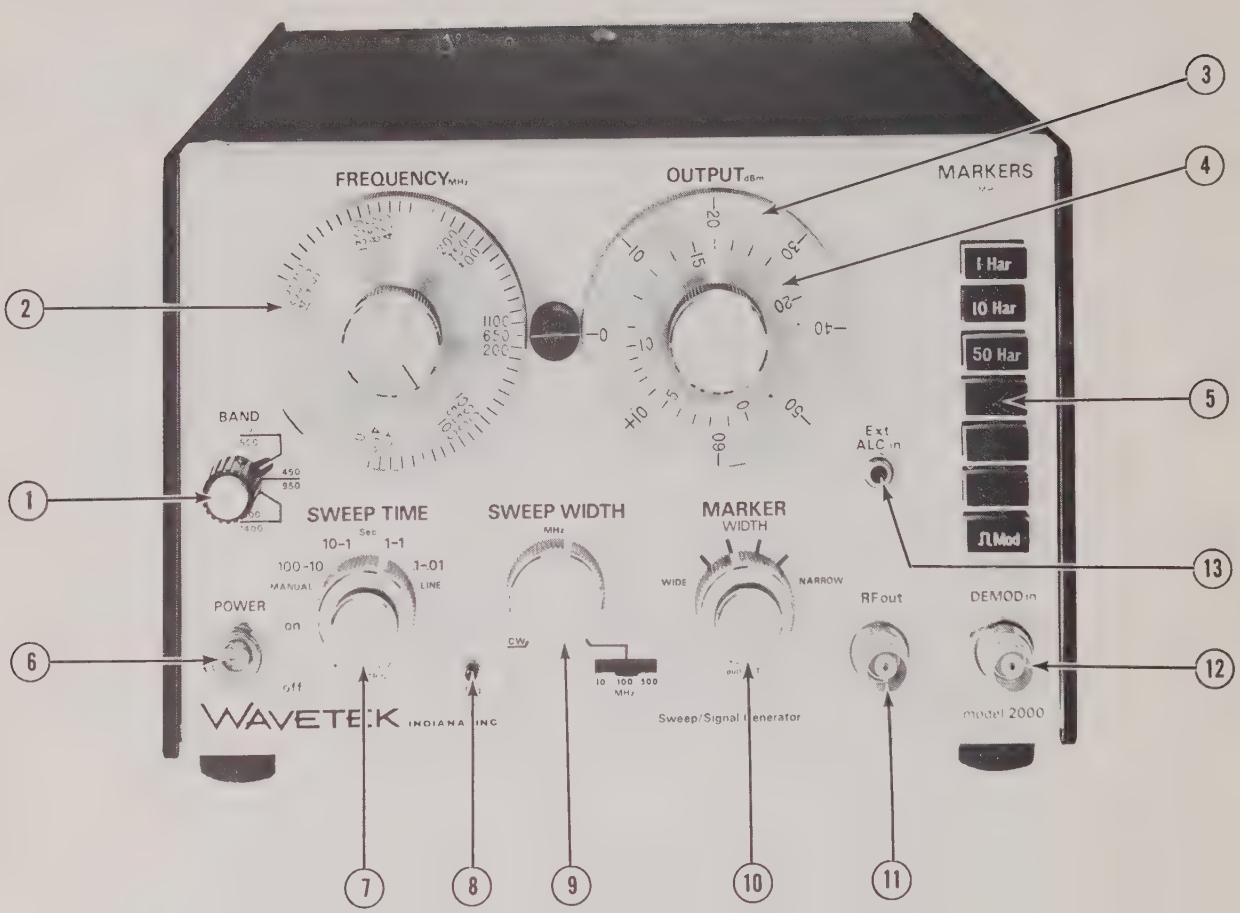


Figure 3-1. Front Panel

3.2 DESCRIPTION OF FRONT PANEL

(1) BAND - Switch desired band; 1 to 500 MHz, 450 to 950 MHz or 900 to 1400 MHz.

(2) FREQUENCY - A dual concentric center frequency tuning control. The Outer (coarse) knob calibrated in 10 MHz increments. The Inner (vernier) knob provides approximately ±5MHz tuning range about the center frequency set by the coarse control.
NOTE: The coarse control will be on calibration when the calibration line of the vernier knob is aligned with the indicator line.

(3) OUTPUT (Step) - Provides calibrated adjustment of the RF output in 10dB increments, from +10dBm to -60dBm.

(4) OUTPUT (Vernier) - Provides a 20dB vernier adjustment of the RF output. calibrated in 1dB increments.

(5) MARKERS - (MHz) - Six push button switches, control A-1 and A-2 Marker Options (marker frequency is engraved on push button). The seventh button controls Modulation Option A-4.

(6) POWER - Power switch applies a.c. power to the power supply. The pilot light indicates the instrument is operating.

(7) SWEEP TIME SEC VAR/MANUAL pull TRIG - This is a six position Switch/Control. The Outer knob provides selection of MANUAL, LINE, or four Decade ranges of variable sweep time. The Inner knob provides manual frequency sweeping when SWEEP TIME SEC switch is set to MANUAL, and variable adjustment of sweep time in each of the four decade ranges. The sweep may be changed from recurring to triggered by pulling the knob out. (The sweep may be triggered in the four decade ranges only.)

(8) Trig - Momentary contact switch, triggers the sweep in the triggered mode for single sweep operation.

(9) SWEEP WIDTH - Control and three position slide switch. Control logarithmically adjusts the displayed sweep width from less than 200 kHz to over 500 MHz when the slide switch is in the 500 MHz position. When switched to the 100 or 10 MHz positions, the maximum sweep width is reduced as indicated. Full counterclockwise rotation of the control will switch the instrument to a continous wave mode of operation.

(10) MARKER WIDTH SIZE pull TILT - Dual concentric control; Outer knob adjusts marker width from 15 to 400 kHz in four steps; Inner knob controls marker size, and when pulled out, activates the marker TILT feature. When the marker TILT is activated, full counterclockwise rotation of the control will provide horizontal markers with an amplitude of approximately 10% of the total horizontal display. Clockwise rotation will produce a varying amount of tilt toward the vertical axis.

(11) RF out - BNC connector provides a connection for the RF output signal.

(12) DEMOD in - BNC connector accepts the demodulated swept signal from the device under test, so that RF markers may be added. (The combined signal is available at the SCOPE VERT connector on the Rear Panel.)

(13) EXT. ALC in - Phone jack connector accepts an automatic leveling control signal from a remote monitor and disconnects the internal ALC loop. (Mates with Switchcraft type 750 plug.)

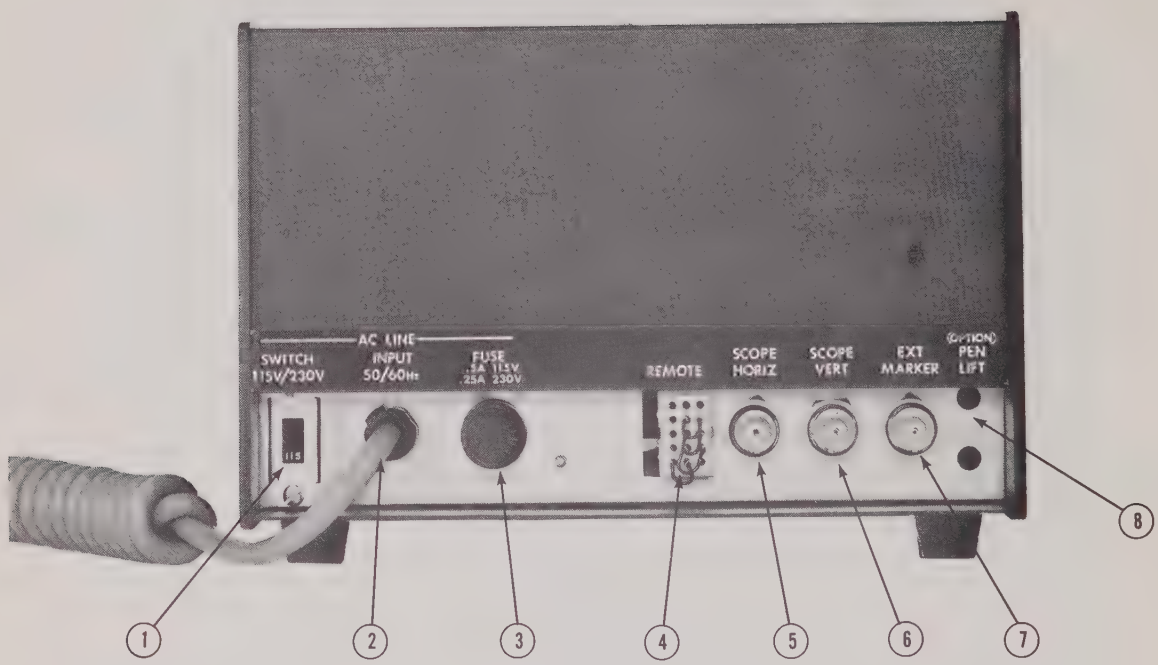


Figure 3-2. Rear Panel

3.3 DESCRIPTION OF REAR PANEL

(1)	SWITCH 115/230 volt-	Selects 115 or 230 volt line voltage.
(2)	INPUT 50/60 Hz -	3 prong AC plug provides connection to AC mains.
(3)	AC LINE FUSE -	0.5A for 115 volt AC or 0.25A for 230 volt AC.
(4)	REMOTE	Jack provides connection for programming of frequency, sweep width and RF output level. (See paragraph 3-6 for detailed instructions.) This jack is supplied with a mating "jumpered plug" which provides Front Panel control.
(5)	SCOPE HORIZ	BNC jack provides connection to horizontal (X) axis of oscilloscope or plotter.
(6)	SCOPE VERT	BNC connector provides the combined markers and demodulated RF (when Front Panel DEMOD INPUT is connected) for connection to the oscilloscope Vertical (Y) axis input.

(7) EXT MARKER — BNC connector accepts an externally generated Continous Wave signal to produce a frequency marker on the display.

(8) (OPTION) PEN-LIFT - When Pen- Lift Option is installed, these 2 terminals provide contact closure during sweep "ON" time. This option operates only when the Front Panel SWEEP TIME Selector is set to the 100-10 SEC position.

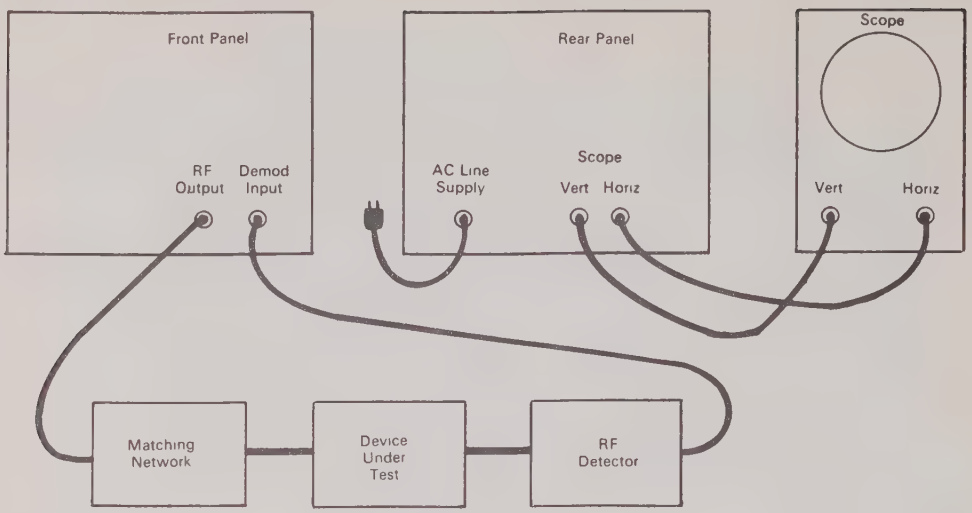


Figure 3-3. Typical Operating Set-up

3.4 TYPICAL OPERATING SET-UP

When initially setting up instrument, first check Rear Panel AC LINE VOLTAGE Selector Switch and Fuse to ensure the instrument is set for operation with the available AC mains.

Make connections between the Sweep Generator, the device under test, and the oscilloscope as shown in Figure 3-3. Since hum, RF leakage, and spurious signal pick-up must be kept to a minimum, it is essential that good connections and grounds be maintained throughout the entire set-up. Use coaxial cables with BNC connectors wherever possible. The RF OUTPUT cable is especially critical. It should match the output impedance of the Sweep Generator and should be kept as short as practical (under 3 feet). If the input impedance of the device under test is not the same as the sweep generator output impedance, a matching network, as shown in Figure 3-3, should be used to ensure a constant amplitude input signal to the device under test.

After the RF signal passes through the RF circuit of the device under test it must be demodulated before being connected to the DEMOD in of the Sweep Generator. If a demodulator is not a part of the device under test, one must be added externally. (See Figure 3-3.) The input impedance of the demodulator must present the proper load to the RF circuit being tested. The Wavetek Model D151 or D152 RF Detector is recommended for 50-ohm applications and the Model D171 for 75 ohm applications.

Turn POWER switch on. The pilot light should light, indicating an operating condition.

(NOTE: This instrument does not require a warmup period unless it is to be used at the extreme limits of its specifications.)

After completing the set-up, adjust the Sweep Generator controls for the required center frequency, sweep width, output amplitude, and sweep rate. Turn the desired markers ON and adjust their Size and Width.

3.5 SPECIAL OPERATING NOTES

3.5.1 Errors From Sweep Rate Effects

When sweeping RF circuits having rapid amplitude changes, errors may occur, due mainly to detector delays. Decreasing the detector output time constant will minimize this effect. Figure 3-4 illustrates sweep rate effect.

To check for sweep rate effect, first

set the sweep width to its lowest practical amount, then reduce sweep time while closely observing the swept output response. Any change in the response indicates the sweep rate is too fast for a true response. When a further reduction of sweep time does not change the response, a true response has been obtained.

3.5.2 Effects From Overloading

The use of excessive input signals to the device under test can cause overloading. To assure that this condition is not present, and that the response is a true representation of the device under test, turn the OUTPUT dBm controls to minimum output amplitude. Gradually increase the output amplitude until a response is obtained. Further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just far enough to restore the proper configuration.

3.5.3 Making Measurements at Low Levels

When making measurements at low levels, radiation and ground loops become problems. Using double shielded cables for cables carrying RF signals helps minimize the radiation problems. Ground loops causing hum pick-up can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the scope horizontal input. If the ground connection is made at the vertical input terminal an additional ground at the horizontal input terminal will often result in hum pick-up.

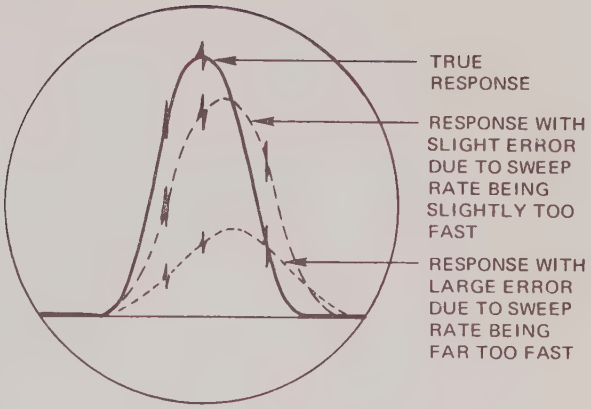

TRUE RESPONSE
RESPONSE WITH SLIGHT ERROR DUE TO SWEEP RATE BEING SLIGHTLY TOO FAST
RESPONSE WITH LARGE ERROR DUE TO SWEEP RATE BEING FAR TOO FAST

Figure 3-4. Sweep Rate Effects

3.5.4 Operation With X-Y Plotters

Two features are incorporated into the Sweep Generator to facilitate operation with X-Y plotters. First, a Marker Clamp Switch converts the hi-frequency marker signals to a lower frequency which is compatible with the operating speed of the plotter pen. This is an internally operated switch, located directly behind the Front Panel DEMOD input jack, and is accessible by removing the instrument bottom cover.

Second, an optional feature, (A-5), provides a Contact Closure during the sweep time to operate the plotter's Pen-Lift. The A-5 feature operates only when the SWEEP TIME selector switch is set to its slowest position, 100 to 10 SEC.

3.5.5 Operation With Network Analyzers

To operate properly with certain network analyzers several modifications might be required. Some analyzers require the removal of the blanking signal during the sweep return trace. This can be accomplished by disconnecting the single wire connected to pin 10 of the M1H Module. Another modification sometimes required is to provide a horizontal output ramp that varies from zero to some positive voltage instead of the standard -8 to +8

volt ramp. This can be accomplished by connecting a 56 K ohm resistor between pins 2 and 11 of the M1H Module. This connection provides a horizontal output signal from approximately 0 to 11 volts.

3.5.6 Operating With An External Monitor

Operation with an external monitor can produce a flatter (less amplitude variation) input signal to the device under test than is obtainable with the internal monitor. The external monitor point is located at the point where greatest flatness is desired and is not affected by cable VSWR or input impedance of the device under test. Another application is to level at the output point of a Wide Band Power Amplifier, in order to increase the output power capability of the Sweep Generator.

To operate with an external monitor; First, set the OUTPUT controls for maximum. Next, connect the output from the External Monitor to the Front Panel phone jack labeled ALC in. The signal from the external monitor must be of a negative polarity between 0.2 and 2 volts. If the signal is larger than 2 volts, use a resistive divider to obtain less than 2 volts. While observing the output from the monitor on an oscilloscope, adjust the Vernier OUTPUT Control until the monitor signal becomes leveled. (Refer to Figure 3-5.)

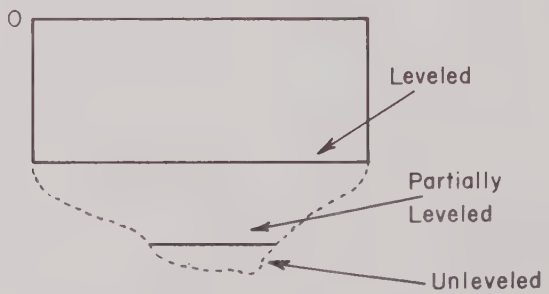
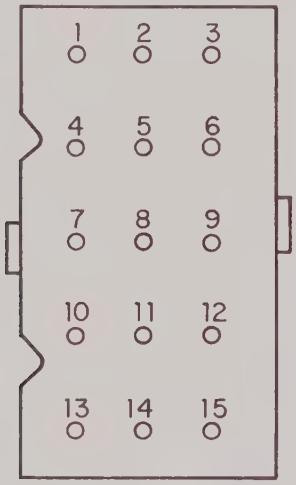


Figure 3-5.

3.6 PROGRAMMING

Connections for remote operation of OUTPUT AMPLITUDE, FREQUENCY, and SWEEP WIDTH plus EXTERNAL AM and FM MODULATION and triggering of the sweep circuit is provided by a Rear Panel REMOTE programming connector. The programming jack and its pin functions are shown below.



Rear Panel
Remote Jack J 101

VOLTAGE AND SIGNAL SOURCES
Pin 1 - Ground
Pin 2 - +16 volts
Pin 3 - -16 volts
Pin 4 - -18 volts
Pin 10 - Ramp for driving Sweep Width Control

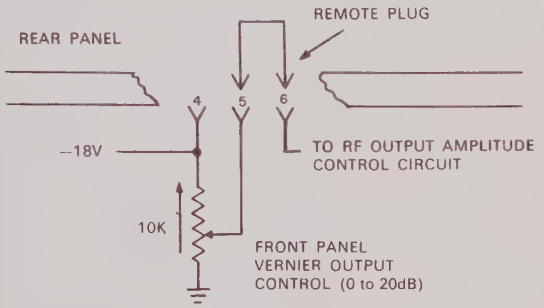
CONTROL INPUTS
Pin 6 - Output Level Control (AM Modulation)
Pin 7 - Sweep Time, Trigger Input
Pin 9 - Frequency Control
Pin 12 - Sweep Width Control (FM Modulation)

INTERNAL CONTROL
Pins 5, 8, and 11 are used to program internal operation of Output, Frequency and Sweep Width.

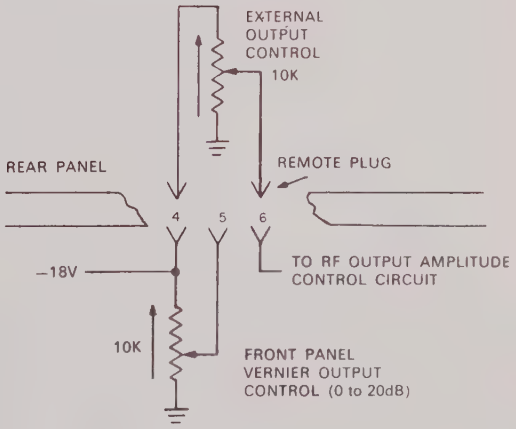
UNUSED
Pins 13, 14, and 15 are unused.

3.6.1 Output Amplitude Control (AM Modulation)

Normal internal control is provided by a jumper wire connected between pins 5 and 6 of the REMOTE plug as shown below.



To provide external control, remove jumper wire and connect an external OUTPUT Control as shown below. The RF OUTPUT is a linear function of the programming voltage as shown in Figure 3-6.



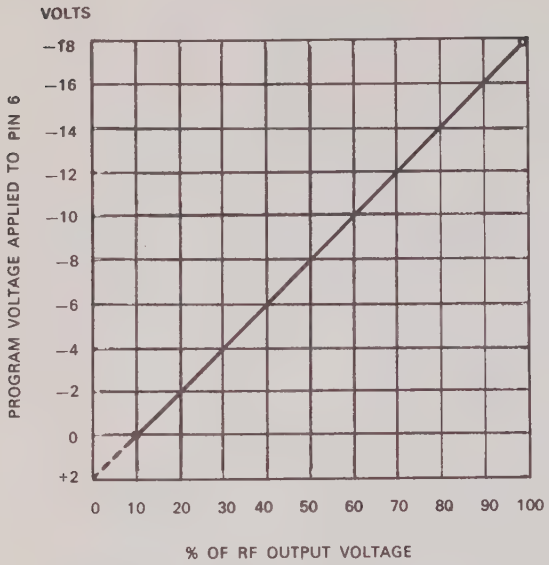
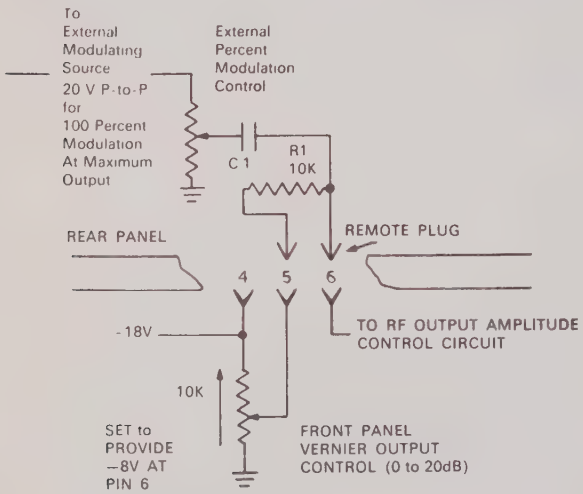


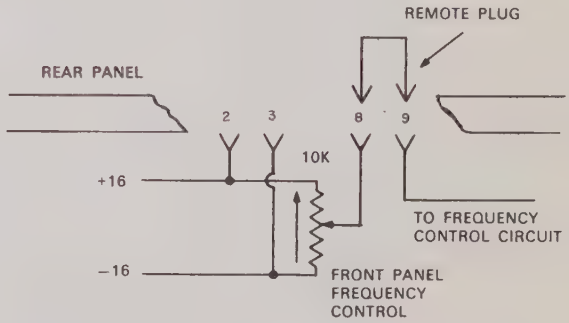
Figure 3-6. Program Voltage/RF Output

To provide AM MODULATION, connect as shown below. The low frequency modulation will be limited by the reactance of capacitor C1. Lower frequency modulation, down to DC, can be provided with a modulating source having a DC offset. In this case, resistor R1 is omitted. In all cases, the peak modulating voltage plus the DC offset must be within the limits of -18 to +2 volts, as shown in Figure 3-6, or distortion will occur. The modulation frequency limits the maximum usable percentage of modulation as shown in Figure 3-7. This graph was obtained with the DC level set to -8 volts.


To External Modulating Source 20 V P-to-P for 100 Percent Modulation At Maximum Output
External Percent Modulation Control
C 1
R1 10K
REAR PANEL
REMOTE PLUG
4 5 6
-18V
TO RF OUTPUT AMPLITUDE CONTROL CIRCUIT
10K
SET to PROVIDE -8V AT PIN 6
FRONT PANEL VERNIER OUTPUT CONTROL (0 to 20dB)

3.6.2 Frequency Control

Normal internal control of frequency is provided by a jumper wire connected between pins 9 and 8 of the REMOTE plug as shown below.



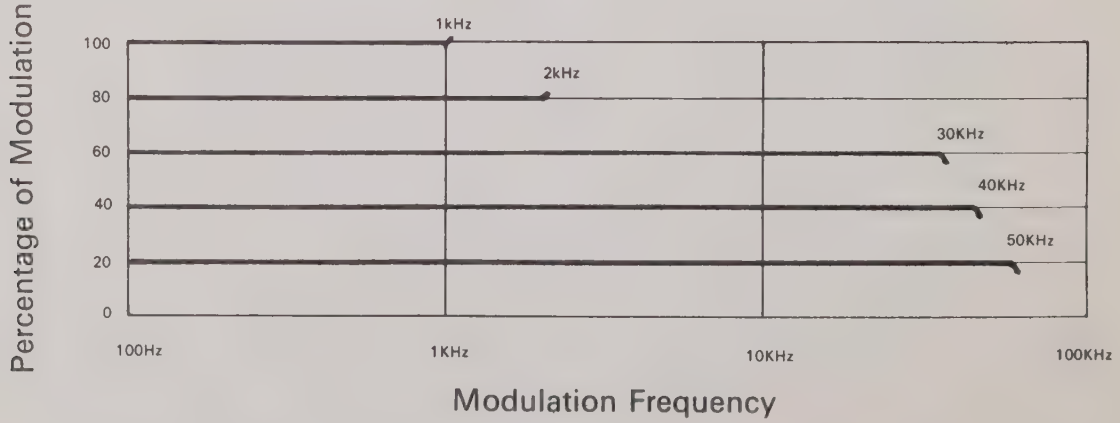
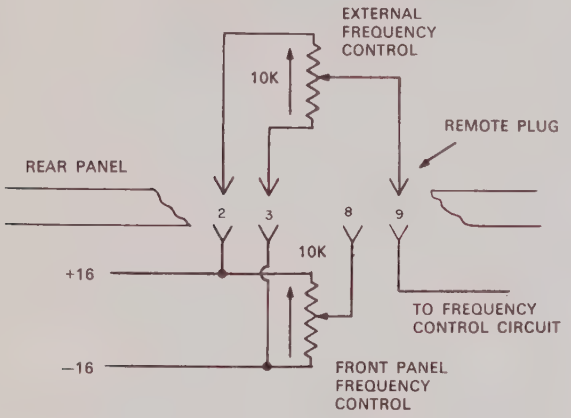


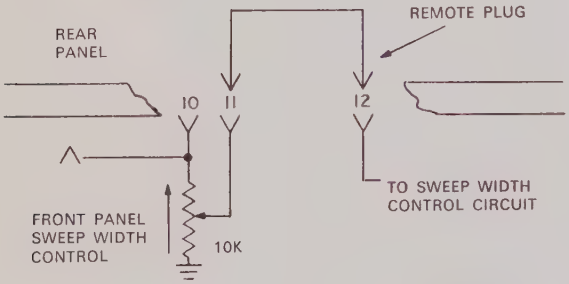
Figure 3-7. Percentage Modulation/Modulating Frequency

To provide external control, remove the jumper and connect pin 9 to an external frequency control as shown below. Tuning sensitivity is shown graphically in Figure 3-8.

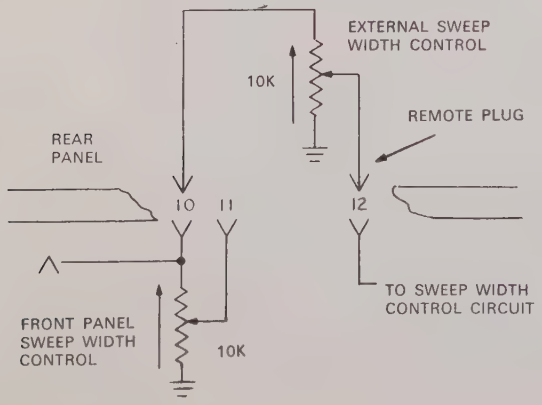


3.6.3 Sweep Width Control (FM Modulation)

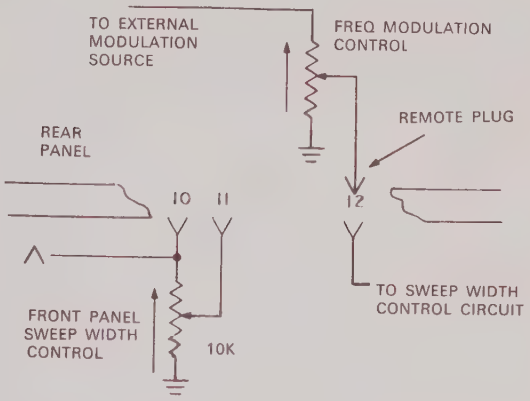
Normal internal control of Sweep Width is provided by a jumper wire from pins 11 to 12 of the REMOTE plug as shown below.



To provide external control, remove the jumpers and connect pin 12 to an external Sweep Width control as shown below.



To provide FM modulation, connect as shown below and set the Sweep Width Control for CW operation.



The modulating wave form should have an average potential of zero volts. Frequency sensitivity, is shown graphically in Figure 3-8. The maximum modulating frequency, while still maintaining this sensitivity, varies from approximately 4 kHz at maximum deviation to 20 kHz for 1 MHz deviation. (See Figure 3-9.) With decreased frequency sensitivity, frequency up to 200 kHz can be used, as shown in the shaded area of Figure 3-9.

The peak amplitude of the modulating signal plus the DC voltage supplied to the Frequency Control (pin 9 of REMOTE plug) should not exceed + or -16 volts. This amplitude would program the unit to sweep beyond the band limits.

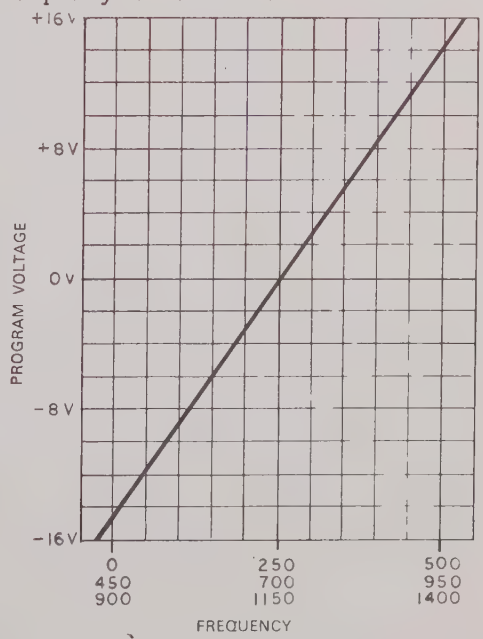


Figure 3-8. Program Voltage/Frequency

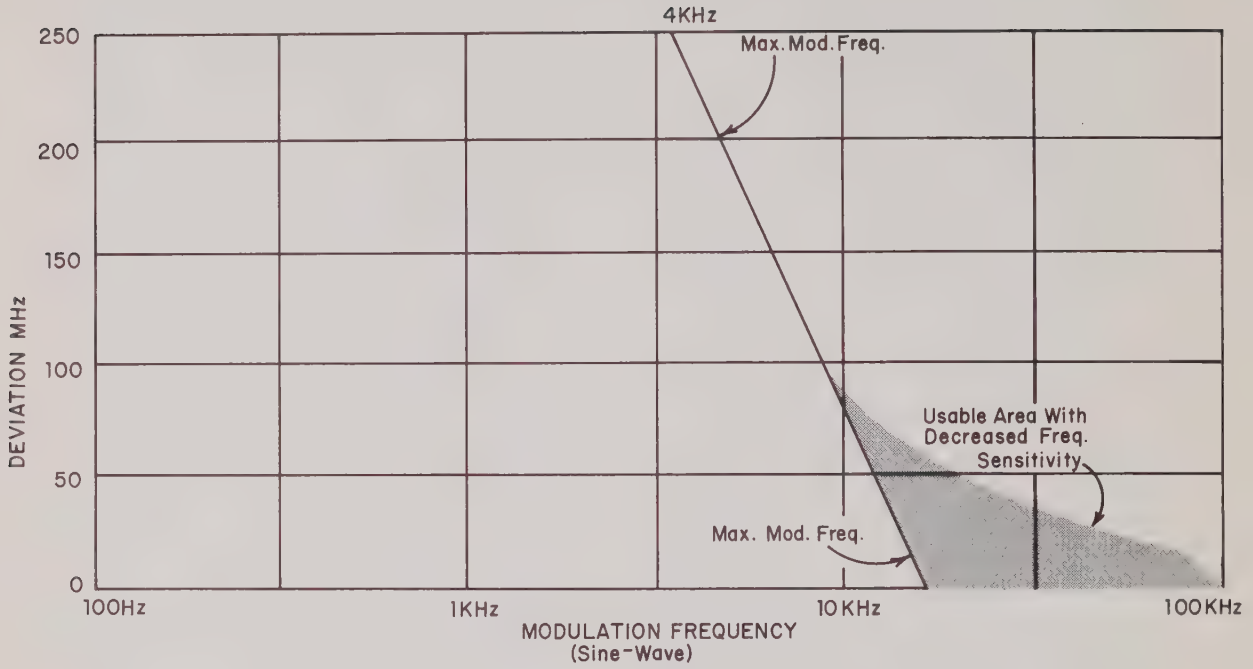


Figure 3-9. FM Modulation Frequency Limits

3.6.4 Remote Triggering of Sweep Time Circuit

The Sweep Time Circuit can be remotely triggered by applying a 10 volt positive pulse to pin 7 of the REMOTE plug. For proper operation, the Front Panel SWEEP TIME Selector must be set for one of the four variable sweep time positions, and the PULL/TRIG Switch set to its OUT position. The repetition rate of the external trigger should be slower than the free-running rate set by the Front Panel SWEEP TIME Selector and VAR/MANUAL Control.

SECTION 4
CIRCUIT DESCRIPTION

4.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each module.

Before beginning the actual circuit description it would be well to consider the mechanical arrangement of the instrument. This will enable the following block diagram and circuit description to be associated with its physical position, thereby, providing a better understanding of the overall instrument. The mechanical arrangement can be seen by referring to Figure 5-14 in the Maintenance section. This TOP VIEW shows the Front Panel, plug-in module, and the rear chassis Power Supply sections.

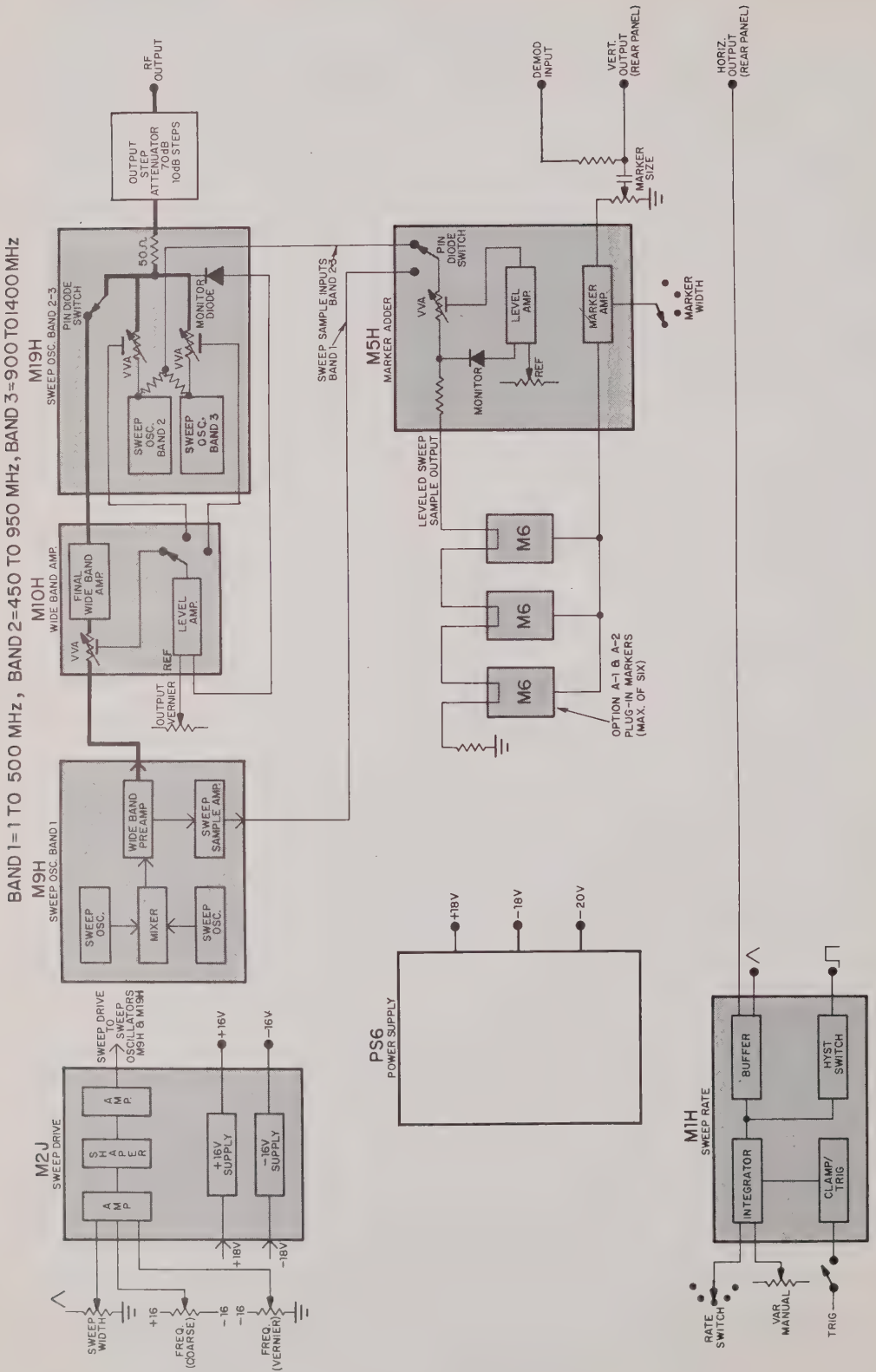


Figure 4-1. Simplified Block Diagram

4.2 FUNCTIONAL BLOCK DIAGRAM

The block diagram in Figure 4-1 contains both block and module information. The blocks contained within each module are indicated by the module outline.

The Power Supply provides three regulated voltage sources of +18, -18, and -20 volts for connections to the plug-in modules.

The M1H module generates the sweep ramp, blanking, and scope horizontal voltages.

The M2J module contains three distinct circuits; a -16 volt reference supply, a +16 volt reference supply, and the sweep drive circuits.

The two reference supplies and the sweep ramp voltage provide the signals to the Front Panel FREQUENCY and SWEEP WIDTH controls. The signal from these controls is then fed to the sweep drive circuit in the M2J module, where they are combined into a single signal, which drives the frequency determining varactor diodes in the sweep oscillator modules. Necessary level shifting, shaping, and amplitude control is provided by the sweep drive circuit.

The RF signal for BAND 1 (1 to 500 MHz) is generated in the M9H module where the signal from two sweep oscillators are combined in a diode mixer. The resultant, difference signal, is fed to a 1-500 MHz preamplifier and then to the M10H module. This module contains a voltage variable attenuator (VVA) and the final 1-500 MHz amplifier. The output from this amplifier is then fed to the M19H module where a PIN diode switch completes the circuit to the RF output.

Leveling of the RF output is accomplished by a monitor diode which measures the RF voltage and compares it to a reference voltage supplied by the output vernier control. Any error between the two voltages is amplified in the leveler amplifier located in the M10H module. The error voltage is then connected to the voltage variable attenuator(VVA) at the input of the final 1 to 500 MHz amplifier. This closed loop system maintains a constant amplitude RF signal at the monitor point which compensates for amplitude variation in the sweep oscillator, mixer, and amplifier circuit and also creates a zero impedance at the monitor point.. In order to create a 50ohm source impedance, a 50 ohm resistor is connected between the zero impedance point and the RF output system.

The sweep oscillator for bands 2 and 3 is located in the M19H module. The RF output from the oscillator is fed through a voltage variable attenuator directly to the RF output circuit without amplification. Leveling for bands 2 and 3 is accomplished in the same manner as for band 1.

The marker circuit is comprised of the marker adder module M5H and the individual marker generators M6's. In addition to the marker adding function of the M5H module, it also provides for selection and leveling of the sweep sample signal in the same manner as the main RF output signal was leveled. This provides a constant amplitude sweep sample signal to the individual marker modules which is extremely important to obtain a "flat comb" output from the harmonic generating marker modules. It also standardizes the sweep sample amplitude in all instruments which ensures proper operation of field installed markers.

This constant amplitude sweep sample signal is then fed to the individual M6 marker module where it is combined in a mixer with a crystal controlled CW signal. The resultant, difference signal, which is the birdy marker is then fed back to the marker adder module where it is combined with other birdy markers, shaped, and amplified into a single com-

posite signal. This signal is then fed through the marker size control and to the Rear Panel vertical output connector.

THE FOLLOWING CIRCUIT DESCRIPTIONS ARE REFERENCED TO THE SCHEMATICS APPEARING IN SECTION 6.

4.3 POWER SUPPLY (PS6)

The PS6 power supply provides three regulated voltages and an optional "pen-lift" circuit.

AC POWER & RECTIFIER CIRCUITS
A dual-primary transformer allows operation at a line voltage of 115 or 230 volts. AC power is supplied through a 4-wire receptacle from the Front Panel ON/OFF switch. The transformer is located away from the sweep drive module to reduce magnetically coupled line ripple. Unregulated plus and minus voltages are supplied by two full wave rectifier circuits and filtered by capacitors C1 and C7. A 12-pin plug, mounted to the printed circuit board, provides access to three unregulated voltages as well as the regulated +18, -18, and -20V. This plug also accepts a scope horizontal signal for connection to a Rear Panel connector. The pen-lift switching circuit is also enabled through this plug.

PEN-LIFT OPTION
Installation of K50 and Rear Panel jacks provides a contact closure occuring during the sweep on-time. Transistor Q11 is normally conducting from current supplied through pin 9 of the 12-pin plug. When the base drive to transistor Q11 is removed, the relay is energized by the turn-on of transistor Q12. To prevent early failure of the relay contacts, the relay is only energized during slow sweep speeds and in the manual position of the Front Panel sweep rate selector.

+18 VOLT SERIES REGULATOR
Regulation is provided by IC1 which contains its own internal reference supply. Resistor R9 provides an adjustment to +18.00 volts. An external pass transistor, Q2, boosts the current capability, and transistor Q1 improves the current limiting characteristics of IC1 by providing amplification before limiting. The +18 volt supply is protected against reverse voltage by diode CR7.

-18 VOLT SERIES-SHUNT REGULATOR
The voltage reference for this supply is obtained from the +18volt supply through resistor R20. Resistor R19 provides feedback, applied to IC2, which provides high gain, forcing transistor Q5 to maintain a shunt regulated voltage across resistor R13. Transistors Q3 and Q4 provide the series pass element and are connected as a compound emitter follower so that the voltage across resistor R13 is not loaded heavily. Short circuit protection of transistor Q5 is provided by diode CR8. Current limiting is provided by transistor Q5, when transistor Q6 conducts sufficiently to forward bias diodes CR9 and CR10. Reverse voltage protection is provided by diode CR12.

-20 VOLT SERIES REGULATOR
The reference voltage for the -20V supply is applied to a differential amplifier, transistors Q9 and Q10, which control the conduction of the series pass transistor Q8.

Diode CR17 provides reverse voltage protection. Current limiting is provided by shutting down of the -18 volt supply by transistor Q7 through diode CR14 to the base of transistor Q5, reducing the reference voltage to the base of transistor Q9. This action is helped along by the conduction of diode CR13 if the -20 volt supply drops below -18 volts.

4.4 SWEEP RATE (MODULE M1H)

M1H SWEEP RATE GENERATOR
This module generates a variable rate square and triangular waveform. Front Panel switching provides recurring, trig

gered, or manual modes. The triangular waveform is a 32 volt peak-to-peak signal with a sweep time variable from 10ms to 100 seconds in four steps, with retrace time held constant at the fastest sweep time of each range. The triangular waveform is used to provide the sweep drive and the scope horizontal signals.

The square wave output is a -1 to +15 volt signal whose -1 volt level corresponds to the sweep time and whose 15 volt level corresponds to the retrace time. The square wave is used to provide blanking of the RF output during retrace time.

Triangular waveforms are generated in an integrator, transistors Q1, Q2, A3, and Q4, by applying positive and negative voltage levels to the integrator input. When the integrator positive ramp output exceeds a threshold voltage, a bi-stable hysteresis switch is switched, reversing the polarity of the integrator dc input, causing the triangular waveform to start down toward another threshold. If the module is programmed in a recurring mode, the negative ramp will trip the hysteresis switch producing continous oscillations. The hysteresis switch output is clipped on the negative polarity and is used for blanking (pin 10).

The symmetrical square wave output from the hysteresis switch (pin 9) is connected, through the Front Panel SWEEP TIME vernier and one of the range determining resistors of the SWEEP TIME selector switch, to the integrator input (pin 7). Since the integrator output voltage change is proportional to the input voltage level, the SWEEP TIME vernier provides a sweep time increase by reducing the hysteresis switch output if the polarity is negative. If the polarity is positive, full output is retained (a diode opens the vernier ground connection)producing a nearly constant retrace time.

For triggered modes, the negative threshold of the hysteresis switch is shifted out of the way by a diode, and resistor connected through transistor Q14, or through switch S102D, when in "line" position. The integrator will now continue its negative ramp until it is stopped by a clamp circuit turned on by a comparator. The integrator output is now held at this level unless a trigger is applied to the hysteresis switch. A trigger cannot flip the hysteresis switch until this clamp level is reached because the triggers must pass through an amplifier which is gated off until the clamp comparator transistor (Q9) conducts.

Triggers are prevented from reaching the hysteresis switch (pin 6) by a voltage at pin 1, which causes comparator transistor Q8 to open FET switch Q14. The primary function of the voltage at pin 1 is to shift the clamp comparator input out of the way to allow free-running oscillations.

Since the integrator is an inverting amplifier, and both input (pin 7) and output (pin 8) are available, a feedback resistor network allows the SWEEP TIME vernier, R102, to be used as a dc level shifter in the manual mode. A non-inverting amplifier consisting of transistors Q6, Q7 and Q19, with a gain of 2, provides a 32 volt peak-to-peak wave output which is used for sweep drive. This output is divided by resistors R18 and R53 to provide a horizontal drive of about 16 volts peak-to-peak at an impedance of about 23k ohms.

A centering adjustment resistor(R41) provides a dc level adjustment of the integrator and horizontal outputs (pin 8, pin 12, and pin 11) by shifting both positive and negative thresholds of the hysteresis switch. A size adjustment resistor (R45) provides an amplitude adjustment by effectively varying the size of the hysteresis window. Symmetry of trace and retrace time (for equal positive and negative input voltages to the integrator) is established by adjusting the integrator balance control resistor R7. This adjustment also affects the

manual mode centering and the sweep period for fully counterclockwise rotation of the SWEEP TIME vernier.

The four sections of the SWEEP TIME selector switch program the M1A module. The functions of each section are listed below:

Section A	Integrator input selector
Section B	Clamp level shift and routing switch disconnect
Section C	Trigger source selector
Section D	Line trigger routing, and hysteresis switch hold

Circuit operation as modified by the switch positions may be understood by considering the MANUAL, VARIABLE RATE, and LINE positions one at a time.

MANUAL POSITION
Section A. A feedback resistor, R113, is connected from output (pin 8) to input (pin 7)of the integrating amplifier converting it to an inverting dc amplifier. Resistor R114 shifts the amplifier output dc level to -8 volts for zero input voltage to resistor R104. When the SWEEP TIME vernier control resistor R102 is fully clockwise, the negative input voltage to R104 is sufficient to shift the output voltage to +8 volts dc.

Section B. The clamp is disabled in this position by applying +18V to pin 1, causing the hysteresis switch input to be disconnected from any internal source of triggers, by opening the routing switch transistor Q14 (since transistor Q8 is turned off). The shift bias is disconnected when transistor Q14 is open.

Section C. The trigger input point, pin 4, is grounded.

Section D. The hysteresis switch is held in one state by applying -18 volts to its input through a 33k ohm resistor. This causes the output to be negative. This bi-stable circuit is a positive feedback amplifier. providing the proper polarity to resistor R102 and preventing blanking of the RF output.

VARIABLE RATE POSITIONS
Section A. Proper integrator input resistors are selected in decade increments in these positions; R105 - R108.

Section B. The clamp is disabled and triggers are held off unless the "pull trigger" switch is opened, removing +18 volts.

Section C. Two trigger sources are connected to pin 4; an external trigger from REMOTE jack J101-7 and triggers from the Front Panel momentary TRIG switch S103.

Section D. No connection is made to pin 6 in any of the variable rate positions.

LINE POSITION
Section A. The proper value integrating resistor is selected, by-passing the SWEEP TIME vernier, to produce equal sweep and retrace periods.

Section B. Clamping works in this position independently of the "pull trig" switch.

Section C. The line rate square wave from the power supply is connected to the trigger input.

Section D. Amplified triggers are routed into the hysteresis switch independently of the internal routing transistor, providing additional (redundant) line rate reliability.

4.5 SWEEP DRIVE (MODULE M2J)

The M2J module provides the correct sweep drive voltage required by each oscillator as programmed by the Front Panel Tuning controls, Sweep Width controls, and the Band switch.

These programs are summed to a standard voltage level and then feed shaping circuits for each band which are enabled by the B-1, B-2 and B-3 voltages.

The shaping diodes conduct at levels determined by a variable resistor network driven by a constant current source, transistor Q4.

As each diode conducts, an additional current is fed into the summing junction of the output amplifier consisting of transistors Q8, Q9, and Q10.

The output waveform amplitude is controlled by resistors R42, R44, and R46 which are connected by switch transistors Q11, Q12 and Q13 into the feedback path to the summing junction.

This module also provides two regulated voltages for use primarily as programming voltages.

4.6 SWEEP OSCILLATOR, BAND 1 (MODULE M9H)

The RF sweep signal for band 1 is developed by the hetrodyne method which utilizes two UHF sweep oscillators, a diode mixer, and a wide band RF amplifier.

Sweep oscillator, transistor Q2, sweeps from approximatley 1.4 to 1.65 GHz. The average frequency is adjusted by resistor R2 which controls the average bias on the varactor diodes, CR1, CR2, and CR3. The sweep drive voltage from pin 9 of the module is connected to the opposite side of these diodes causing the frequency to vary above and below this average frequency in a low-to-high frequency direction.

Sweep oscillator transistor Q5 is similar to the Q2 circuit, however, the varactor diodes have been reversed and the polarity of the bias voltage supplied by R12, COARSE adjustment, and R13, CENT. FINE adjustment, has been changed. These changes cause the oscillator frequency to vary from a high-to-low frequency. The approximate output frequency is 1.4 and 1.15 GHz. This out of phase sweep technique has several advantages. First, larger sweep widths are obtainable and second, the nonlinearity (FREQ versus TIME) of one oscillator is cancelled by the nonlinearity of the second oscillator. Resistor R9, which is a linearity adjustment, optimizes this cancelling process by controlling the sweep drive ratio between the oscillators.

The two sweep signals are combined in a single balance diode mixer comprised of inductors L4 and L5 and diodes CR8 and CR9. The resultant, difference frequency of 0 to 500MHz, is then amplified in the wide band amplifier consisting of transistor stages Q11, Q12, and Q13.

Transistor stages Q6 and Q7 supply the blanking voltage to the wide band amplifier and cause it to be shut off during the sweep retrace time. The output from the wide band amplifier is connected to J1 which in turn is connected to the output wide band amplifier located in module M10H. A second output is also obtained from this amplifier and is coupled, via resistor R45, to a similar wide band amplifier consisting of transistor stages Q14, Q15, and Q16. The output from this amplifier is connected to J2 which in turn is connected to the marker generating circuits.

Transistors Q8, Q9, and Q10 provide a -15 volt supply to operate the sweep oscillators. This improves stability and provides isolation between the oscillators and the -18 volt supply.

4.7 OUTPUT AMPLIFIER, BAND 1 (MODULE M10H)

The M10H module contains a wide band amplifier, an electronic attenuator, and a leveler amplifier.

WIDE BAND AMPLIFIER

This amplifier provides 2 stages of RF amplification to increase the RF input level present at transistor Q1 by about 40dB.

The frequency response of this amplifier is reduced for frequencies near 0.5 MHz

or lower and above 500 MHz.

The input amplifier stage, consisting of transistors Q1 and Q2,is enabled by the B+ 1 switching voltage and the output stage, consisting of transistors Q3, Q4, Q5, and Q6, by the -20 voltage, when the Front Panel band switch is in the Band 1 position. The -20 voltage also provides current through resistor R30 and the RF output cable to turn on a PIN diode, located in the M19H module, which couples the band 1 RF output into the RF output system.

ELECTRONIC ATTENUATOR
Ahead of the first RF amplifier is an electronic attenuator consisting of PIN diodes, CR1, CR2, and CR3 which provides variable RF conductance proportional to the positive current supplied through switching transistor Q7.

LEVELER OUTPUT (PIN 6)
Leveler amplifier transistors Q9, Q10, and Q11 provide leveling of the RF output for Bands 1, 2 and 3 by supplying a positive current to the electronic attenuator system for each band as directed by band switching voltages B-1, B-2, and B-3. These voltages turn on the correct switching transistor for that band in the M10H module or the M19H module.

A positively increasing output voltage from the leveler amplifier will increase the RF output level. RF blanking is effected by a positive input voltage (pin 4) to switching transistor Q8 which causes the leveler output (pin 6) to go negative during sweep retrace time shutting off the electronic attenuator.

LEVELER INPUTS (Pin 5 and Pin 7)
A monitor diode, located external to the M10H, provides a negative DC voltage related to the RF output level present in the output system. The output system and monitor diode is located in the M19H module or in an external monitor circuit. This negative voltage is connected to one input of the operational amplifier, consisting of transistors Q9, Q10, and Q11.

Since an increasingly negative voltage at the input will reduce the positive current supplied to each electronic attenuator, the RF output level is held constant, by negative feedback, at a level determined by a reference voltage. This reference voltage varies under control of the LEVEL PROGRAM input voltage at pin 7 of the M10H module. The magnitude of this negative voltage is determined by the MAX pot which sets the maximum RF level when the program voltage is maximum (-18 volts). The MIN pot provides a small negative reference voltage which determines the minimum RF level when the level program voltage at pin 7 is 0 volts.

4.8 SWEEP OSCILLATOR, BANDS 2 & 3 (MODULE M19H)

This module contains a sweep oscillator with its voltage variable attenuator and the necessary switching circuitry to connect either band 1, band 2 or band 3 to the common monitor and RF output connector.

Band 1 is connected to the RF output circuit by PIN diode CR9. The control current for switching this diode is contained in the M10H module.

Band 2 oscillator, consisting of transistor Q6 and its associated circuitry, is a common base oscillator, varactor-tuned by diodes CR2, CR3, CR4 and CR5.

Biasing of the varactor diodes is provided by transistors Q1 and Q2. Q3 is a switching transistor which disconnects the bias voltage from the varactors when the unit is operated in band 1 or band 3. The B- voltage for the oscillator is modulated by the blanking signal, from pin 4, in transistor stages Q4 and Q5. This modulation causes the oscillator to be cut off during the sweep retrace period, thereby providing a zero RF output level during the retrace time. The RF signal is coupled from the oscillator, by inductor L9, to a voltage variable attenuator consisting of diodes CR6, CR7 and

CR8. This attenuator is part of the closed loop leveling system consisting of the monitor diode CR20, the leveler amplifier, (located in the M10H module) and the voltage variable attenuator. The operation of this circuit maintains a constant amplitude RF signal at the monitor point and also allows adjustment of this signal over a 20dB range. Since the effective impedance at the monitor point is zero ohms, resistor R46 establishes the output impedance at approximately 50 ohms.

Band 3 oscillator is almost identical to band 2. The oscillator tank inductance has been decreased and the oscillator transistor, Q14, is operated at a slightly higher current. The varactor bias is provided by Q9 and Q10 and the B- blanking is provided by Q11 and Q12. Current during the sweep retrace time is not completely removed but is steered by Q13 through CR12. This current will not cause oscillation since L15 has been bypassed. It does, however, provide better frequency stability in the oscillator. The RF signal is coupled from the oscillator, by L20, through the voltage variable attenuator consisting of CR17, CR18 and CR19 and to the RF output.

Q7 and Q8 help provide the proper bias to the shunt diodes in the voltage variable attenuators, in order to maintain a constant load for the oscillator, thus minimizing the frequency pulling effects of the attenuator.

Transistors Q15 and Q16 are switching transistors which connect the output of the leveling amplifier to the voltage variable attenuator associated with the operating band.

4.9 MARKER ADDER (MODULE M5H)

The main function of this module is adding together and amplifying the individual marker signals from the M6 marker modules. It also contains the external marker mixer circuit and the sweep sample selection and leveling circuits.

The desired sweep sample signal (band 1 or band 2 and band 3) is selected by the PIN diode switch CR4 and CR5. The sweep sample signal is then leveled in the same manner as the main RF output signal. The voltage from the monitor, diode CR7, and the reference voltage from resistor R46 is fed to the leveling amplifier consisting of transistor stages Q12 and Q13. Transistor Q11 provides blanking of the leveling amplifier. Any error between the two input signals is amplified and fed to the voltage variable attenuator CR6. The operation of this circuit produces a constant amplitude signal at the monitor point.

The leveled sweep sample signal is connected to the external marker mixer, CR1 and CR2, and to the sweep sample output connector, J4. A 47 ohm resistor, which is connected between J4 and the monitor point, establishes the source impedance at approximately 50 ohms. The signal is then routed to each M6 marker module.

The marker output signals from the individual M6 marker modules are connected to the input pins 1, 2, 3, and 4 of the M5H module. One or two M6 outputs are connected to each input. The signals are then amplified in the input stages, transistors Q2, Q3, Q4, and Q5, and combined in the common collector load. The collector load is an external 10mH choke when the Front Panel MARKER WIDTH Selector is set to "WIDE", or a 3.3k ohm resistor, R21, when the Width Selector is set to "NARROW". The combined marker signals are then amplified in transistor stages Q6, Q7 and Q8. The Front Panel Marker Width SELECTOR also varies the high frequency gain of the amplifier by connecting capacitance across R27, the feedback resistor. The amplified signal is then fed to the complimentary output stage, transistors Q9 and Q10, which is biased so that input signals less than 0.5 volts are not amplified. This eliminates most spurious markers and noise from the output. The output is then connected to the Front Panel MARKER SIZE Control and finally to the Rear Panel SCOPE VERT connector.

4.10 MARKERS (MODULE M6'S)

Each marker module contains a crystal oscillator, a tuned or untuned mixer and a marker amplifier. Harmonic generator marker modules also include one or more harmonic generating stages.

Several types of marker modules are required to cover the wide frequency range and to produce both single frequency and harmonic type markers. A single frequency marker generator produces a marker at a single frequency while the harmonic marker generator produces markers at harmonically related frequencies of the crystal oscillator.

The model number for single frequency markers is M6S followed by the marker frequency. The model number for harmonic markers is M6H followed by the harmonic marker frequency.

The Crystal Oscillator operates between the frequencies of 100 kHz and 55 MHz. Several different types of oscillators are required to cover this range of frequencies. The 100 kHz oscillators use a tuned oscillator with the crystal operating at its fundamental frequency in a series resonant mode. The 1 to 17 MHz crystal oscillators are either tuned series resonant mode oscillators or untuned Pierce type oscillators. The 17 to 55MHz oscillators use a tuned Colpits oscillator with the crystal operating at its third overtone frequency in a series resonant mode. The tuning supresses the crystal fundamental and higher order resonant frequencies. The crystal and marker frequency are the same for frequencies between 100 kHz and 55 MHz. The markers above 55 MHz use harmonic generating techniques.

The output from the crystal oscillator (or harmonic generator) is combined with the sweep sample in the mixer stage. In the case of single frequency markers, the mixer includes a tuned circuit which selects the desired crystal or crystal-harmonic frequency and the sweep sample frequency. In the case of a harmonic marker the mixer is untuned. The mixer circuit is generally a diode mixer although transistor mixers are sometimes used. The fundamental and product signals are filtered from the mixer output, leaving the "difference signal" which is applied to the marker amplifier stage.

The marker amplifier is a single stage amplifier having a frequency response of several kHz to approximately 500 kHz. The output of the marker amplifier is connected through the SIZE Control to the output pin of the module.

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides information for testing, calibrating, and trouble shooting the Sweep Generator. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and trouble shooting sections.

5.2 SERVICE INFORMATION

5.2.1 Disassembly Information

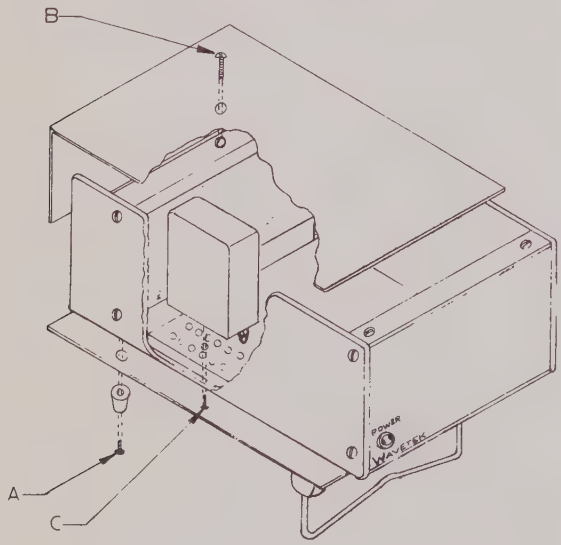


Figure 5-1. Disassembly

REMOVAL OF BOTTOM COVER - Remove the two rear feet (A) and lift cover off with a slight rear movement.

REMOVAL OF TOP COVER - Remove the single screw (B) from the top and lift off cover with a slight rear movement.

REMOVAL OF SIDE PANEL - Either side panel can be removed to provide better access by removing the four screws holding the side panel to the instrument. The Front Panel/Module Section can be removed from the power supply section by removing two screws holding the sections together and by disconnecting the electrical connectors between the two sections. NOTE: Separation of the two sections performs no useful purpose during normal service procedures.

5.2.2 Module Servicing

SERVICE KIT K102 - This kit contains a module extender and RF extension cables which enables the module to be electrically operated while physically located above the rest of the modules, thereby making all parts easily accessible.

REMOVAL OF MODULE - Modules may be removed by removing any cables attached to the top of the module and removing the hold-down screw (C) from the bottom. Pushing up on the module ball studs will help free the ball studs from the chassis mounted spring clips.

REMOVAL OF MODULE COVER - Remove all nuts and screws from top of module and slide the cover off.

REINSTALLING MODULE - Before reinstalling the module, check the module pins for proper alignment, then carefully seat the module pins into the chassis socket and replace the hold-down screw (C) to ensure a good ground connection between module and chassis.

MODULE PIN NUMBERING SYSTEM - The module pins are numbered as shown in Figure 5-2. The ball studs for the circuit modules are located off center to prevent the module's being plugged in backwards. This off-center ball stud location also provides a method for locating pin No. 1.

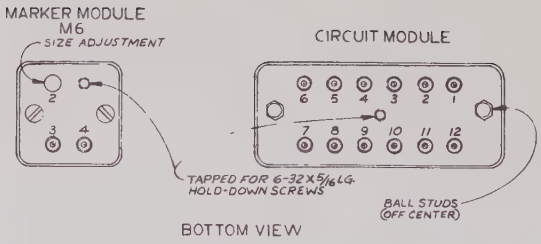


Figure 5-2. Module Pin Numbering System

5.2.3 Transistor Lead Configuration - Transistor lead configurations are shown in Figure 5-3.

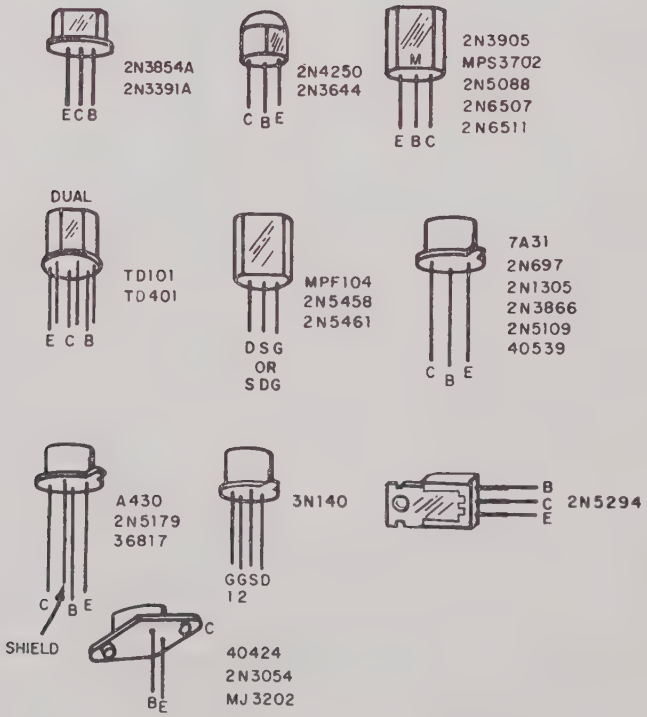


Figure 5-3. Transistor Lead Configuration

5.2.4 Recommended Test Equipment - The following test equipment, recommended for servicing, trouble shooting, and calibrating the Wavetek Model 2000, is shown in Table 5-1.

TABLE 5-1. RECOMMENDED TEST EQUIPMENT

INSTRUMENT	CRITICAL REQUIREMENT	RECOMMENDED
Oscilloscope	DC Coupled 1mV/cm sensitivity	HP-130
Digital Voltmeter	0.1% Accuracy	Weston 1240
Power Meter	Frequency Range 10 to 1500 MHz	HP-437A HP-8485A
RF Detector	Frequency Range 1 to 1500 MHz	Wavetek D152
Spectrum Analyzer	Frequency Range 10 MHz to 3 GHz	HP8555A/8552A
Precision Attenuator Pads	10, 20 & 40dB	Weinschel 50-10, 50-20, 50-40
Marker Generators	1, 10 & 50 MHz Harmonic Markers	Wavetek M6H-1, M6H-10, M6H-50
CW Signal Generator	Adjustable to 925 MHz with 0.1 V output, accuracy ±10 MHz	

5.3 PERFORMANCE CHECKS

The following procedure is intended to ensure the instrument meets its published specifications. The checks specified assume that the instrument is equipped with A-2 Marker Options at 1 MHz, 10 MHz, and 50 MHz. While it is possible to check the instrument's performance without the use of harmonic markers, by using suitable external CW sources, a complete check by this method is impractical. The required performance is shown in paragraph 1.2, Specifications.

5.3.1 Typical Set-Up

Connect the Sweep Generator, RF Detector, and Scope as shown in Figure 5-4.

Adjust the Sweep Generator controls as follows:

FREQUENCY BAND to 0-500 MHz, FREQUENCY to 250 MHz, output dBm to +10, SWEEP TIME to line, pull TRIG and pull TILT to their "in" position, SWEEP WIDTH to its maximum clockwise position and the SWEEP WIDTH RANGE switch to 500 MHz.

Adjust the scope to operate in an X-Y mode. Set the vertical sensitivity to 0.2 volt cm. Adjust the vertical position, horizontal position and horizontal sensitivity to obtain a scope pattern as shown in Figure 5-5. Adjust the Sweep Generator harmonic marker controls as follows. Turn on the 50 MHz markers, adjust the marker width to wide and marker size to produce a marker amplitude similar to that shown in Figure 5-5.

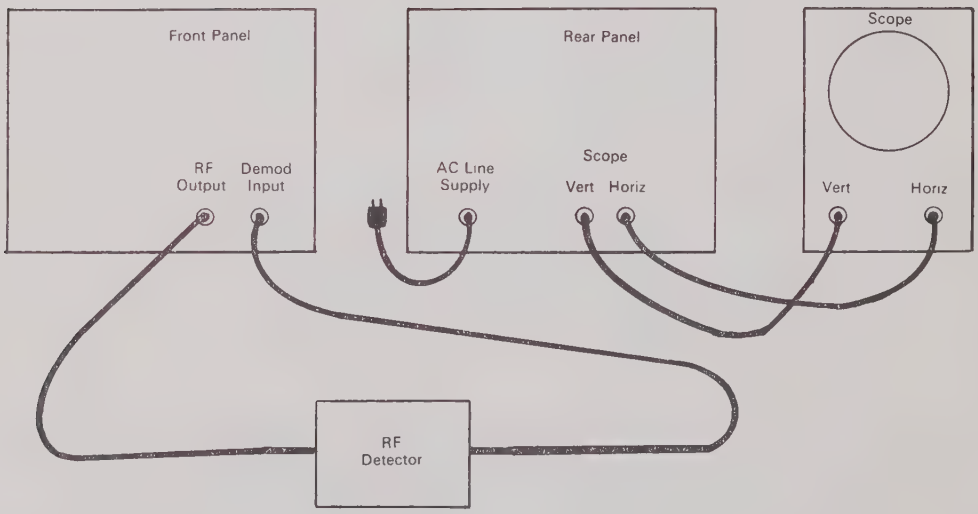


Figure 5-4. Typical Set Up

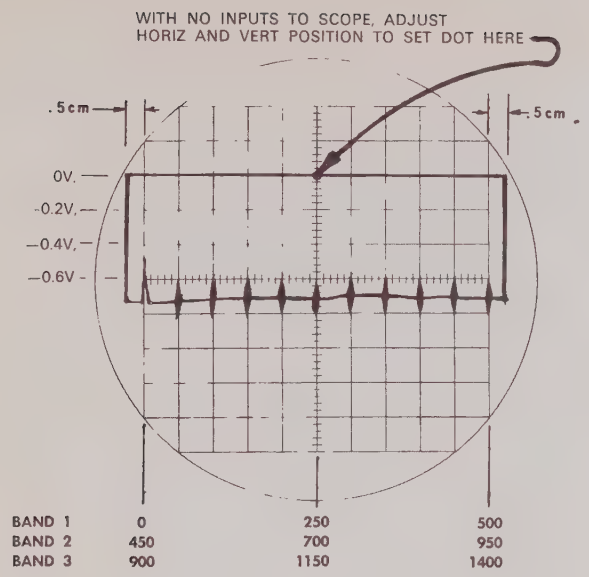


Figure 5-5. RF Detector Display

5.3.2 Display Linearity, Maximum Sweep Width And Frequency Range Check

Display linearity is read directly from the display shown in figure 5-5. Each marker must fall within ±0.2 cm from each centimeter line on the graticule. This is equivalent to a display linearity of 2%. This 2% specification is extremely important since all dial accuracy specifications are directly related to it. Repeat check on BANDS 2 and 3. An external CW signal can be connected to the EXTERNAL MARKER In connector to identify one of the 50 MHz harmonic markers. This also verifies the operation of the external marker circuit.

Maximum sweep width of 500 MHz is also read directly from the display of figure 5-5.

To identify the frequencies shown on the display of figure 5-5 one frequency or marker must be positively identified. All remaining frequencies can be identified by referencing to this frequency. For the 0-500 MHz, low band, the low limit marker is not a marker but the zero lock-in produced by the heterodyne sweep generator technique. The frequency of each marker shown on the display can be identified by referencing to the zero lock-in point. For the 450-950 and 900-1400 MHz bands one frequency can be identified by using an external CW generator and the EXT marker generator circuits of the instrument. By referencing to the marker produced by the known external CW signal, the exact frequency of each marker on the display is obtained.

Since the frequency indicated at the exact center of the display of figure 5-5 is the same as the output frequency when the instrument is operated at minimum sweep width, the center frequency range of the instrument can be checked by simply turning the FREQUENCY (coarse) control to its extremes and noting the range of frequencies indicated at the exact center of the display. The low and high limit markers should move past the display center line by approximately 1/2 cm. This represents approximately a 5% overrange capacity.

To verify low frequency, turn on the 10 MHz harmonic marker and adjust the FREQUENCY (coarse) and SWEEP WIDTH controls to position the zero lock-in point centered on the extreme left scope graticule line and the first 10 MHz harmonic marker centered on the extreme right scope graticule line. Turn on the 1 MHz harmonic markers and, counting down from the 10 MHz marker, locate the marker which corresponds to 1 MHz.

The output must be flat (constant amplitude) down to the 1 MHz marker. This verifies the low frequency limit.

5.3.3 Dial Accuracy Check

Dial accuracy is checked in a manner similar to the frequency range check just completed.

Set the FREQUENCY (coarse) control to position the zero lock-in or the low limit harmonic marker to the center of the display. Reduce the sweep width to approximately 10 MHz to provide the necessary resolution. Turn the 50 MHz harmonic marker off and turn the 10 MHz

harmonic marker on. Center the marker on the display with the FREQUENCY (coarse) control. Make sure the indicator line on the FREQUENCY (fine) control is aligned to the frequency indicator and remains in this position during the entire check. Read the frequency error on the FREQUENCY (coarse) dial. Allowable error is ±10 MHz or 2% of frequency, whichever is greatest. Next, advance the FREQUENCY (coarse) control until the next 10 MHz harmonic marker is centered on the display and again read the error on the FREQUENCY (coarse) dial. Continue this process until the entire frequency range has been verified on all bands. Use the 50 MHz harmonic markers to establish a starting point on the 450-950 and the 900-1400 MHz bands.

5.3.4 Minimum Sweep Width Check

The minimum sweep width of 200 kHz is verified as follows:

Turn the 1 MHz harmonic marker to on. Adjust the FREQUENCY (coarse), FREQUENCY (fine), and the SWEEP WIDTH controls to exactly position a 1 MHz harmonic on the extreme left scope graticule line and the next higher 1 MHz harmonic marker on the extreme right scope graticule line. The scope horizontal is now calibrated for 1 MHz full scale or 100 kHz per centimeter. Adjust the FREQUENCY (fine) control to center a 1 MHz harmonic on the scope display. Adjust the MARKER WIDTH control to produce a marker width slightly greater than 200 kHz. Since the marker presentation has sloping sides it should be possible somewhere along its amplitude to locate a point where its width exactly equals 200 kHz. For example, if the marker is 300 kHz wide at its base and 100 kHz wide at its peak amplitude point, it would be 200kHz wide (2 centimeters) at approximately its 50% amplitude point. Now decrease the sweep width to minimum and ensure that the marker, at the amplitude point corresponding to 200 kHz, covers the entire scope display. Repeat check on all three bands.

5.3.5 Maximum Output Check

Set the BAND switch to 0-500 MHz and the FREQUENCY dial to 300 MHz. Set SWEEP WIDTH control for CW operation.

Turn step and vernier Output controls to indicate +10 dBm. Set power meter to +10 dBm range and connect the power meter's thermistor mount to the RF output connector. The power meter should read +10 dBm, ±.5dB.

5.3.6 Flatness Check

Assuming the sweep generator has been set-up as outlined in paragraph 5.3.1, proceed as follows:

Decrease the scope's horizontal sensitivity to produce a display width of approximately 4 cm. Increase the scope's vertical sensitivity and adjust the vertical position control until the display occupies exactly 10 cm between the zero level retrace line and the maximum amplitude point. Check all three bands to locate the maximum amplitude points. The minimum amplitude point must be 8.9 cm or more for a flatness specification of ±.5dB. Check all three bands to locate the minimum amplitude points.

5.3.7 CW Mode Check

Adjust the sweep width control fully counterclockwise until an audible "click" is apparent. This position removes the return trace blanking and sweep drive from the oscillator. The output frequency is controlled by the FREQUENCY (coarse) and (vernier) controls and the accuracy is identical to the FREQUENCY dial accuracy check performance in paragraph 5.3.3. The output amplitude is the same as in the sweep mode of operation with the absence of the zero level return reference.

5.3.8 Frequency Drift Check

Return to typical set-up of paragraph 5.3.1 and again calibrate the display's sweep width to 1 MHz. Position the marker to the exact center of the oscilloscope display and read frequency drift directly from the scope display by noting the change in the markers position with time. Each centimeter represents 100 kHz. When reading drift over long periods of time, calibrate the display sweep width to 5 MHz, using the 1 MHz harmonic marker. Next turn off the 1MHz marker and turn on the 50 or 10 MHz harmonic markers. Center a marker on the scope display and read drift as before, except each centimeter now represents 500 kHz.

Maximum allowable drift is indicated in paragraph 1.2.

5.3.9 Residual FM Check

Readjust SWEEP WIDTH to produce a calibrated frequency display of exactly 1 MHz for a 10 cm display. Adjust the FREQUENCY (fine) control to center one of the 1 MHz harmonic markers on the scope display. Increase the horizontal sensitivity by a factor of ten. Use the horizontal step V/cm control only and do not turn the horizontal vernier control as this would change the calibration. The display is now calibrated to indicate 10 kHz/cm.

Residual FM can be read directly on the scope display by noting the amount of jitter of the marker.

Change the SWEEP TIME from LINE to the .1-.01 position and again read the marker jitter. Any additional jitter in this position represents the line related residual. Maximum allowable jitter is 15 kHz.

5.3.10 Spurious Signal Check

Checking for spurious signal content is not normally required for periodic calibration, only for incoming inspection. The only practical way to measure spurious signal content is with a high quality spectrum analyzer covering from 10 MHz to at least two times the upper frequency range of the unit to be checked. The spurious check is made in accordance with the instructions furnished with the particular spectrum analyzer being used.

Specifications for spurious signal content is listed in paragraph 1.2.

The heterodyning method of generating the output signal for the 0-500 MHz band will give non-harmonically related spurious signals in addition to the harmonically related signals. These signals are typically 40 to 50dB below the output signal up to 300 MHz and at least 26 dB below the output signal near the High end of the frequency range.

5.3.11 Attenuator Checks

20dB Vernier: The accuracy of the 20dB vernier can be checked using the power meter while operating the instrument in the CW mode. The initial set-up is the same as in paragraph 5.3.5. Maximum Output Check. Once the maximum output has been checked, continue by reducing the vernier output control in 1dB increments until the minimum vernier output has been reached. The power meter reading at each 1dB increment should be within $\pm$.5 dB of the indicated output plus the error at maximum output. If desired, the 20dB vernier can be checked at other frequencies. Overall accuracy is $\pm$.5dB to 500 MHz, $\pm$1dB to 1000 MHz, and $\pm$2dB to 1400 MHz. This error is contributed by the vernier and does not include the basic flatness error at maximum output.

70dB Attenuator: The accuracy of the step attenuator can be measured by using a suitable Attenuation Test Set or by directly substituting precision RF attenuator pads for each 10dB step of the attenuator. The difference between the

two outputs represents the attenuator error. An RF detector can be used to recover the signal at levels down to approximately -40dBm. Below this level an RF amplifier or sensitive receiver (spectrum analyzer) must be used. Allowable error is ±0.5dB to 500 MHz, ±1dB to 1000 MHz, and ±2dB to 1400 MHz. This error is that produced by the step attenuator alone and does not include the basic flatness or the vernier attenuator error.

5.3.12 Sweep Time Check (Horizontal Output Check)

Connect the horizontal output of the Sweep Generator to the oscilloscope vertical input. Adjust the oscilloscope controls for an internally generated, automatic, INT. triggered sweep of 2 ms/cm and a vertical sensitivity of 2V/cm. Adjust the Sweep Generator SWEEP TIME selector to LINE lock and ensure that the pull TRIG switch is pushed in. Adjust the oscilloscope vertical position, horizontal position, and trigger level to obtain the waveform shown in Figure 5-6.

Adjust the Sweep Generator SWEEP TIME selector to .1-.01 position. Ensure that the VARIABLE MANUAL control is fully clockwise. The wait time should disappear and the sweep time should be less than 10ms with approximately equal sweep and retrace time periods. Adjust the oscilloscope time base to 50ms/cm. Adjust the Sweep Generator VARIABLE/MANUAL control fully counterclockwise. The sweep time should be more than 100ms with approximately a 10:1 ratio between the sweep and retrace time periods.

NOTE: The retrace time period remains constant within any one SWEEP TIME range setting and the VARIABLE/MANUAL control varies the sweep time period. With the VARIABLE/MANUAL control fully clockwise the sweep and retrace times are both approximately 0.01 seconds. With the control fully counterclockwise the sweep time becomes approximately 0.1 seconds and the retrace time remains 0.01 seconds. On the next lower range(1-.1) the retrace time would remain 0.1 seconds and the sweep time would vary from 011 to 1 seconds.

Repeat these checks for the 1-.1, 10-1, and 100-10 sec positions of SWEEP TIME selector switch. Adjust oscilloscope time base as necessary to ensure that the VARIABLE/MANUAL control will adjust the sweep time from faster than the maximum to slower than the minimum specifications for each range.

Adjust the SWEEP TIME selector to MANUAL and adjust the VARIABLE/MANUAL throughout its range. A DC voltage should be present that is variable from -8V, ±0.5V with the control fully counterclockwise to +8V, ±0.5V with the control fully clockwise.

Adjust the SWEEP TIME selector to the .1-.01 position and pull the pull TRIG switch. The sweep should now be disabled. Each depression of the Front Panel TRIG switch should produce one complete sweep cycle.

NOTE: The triggered mode of operation is only possible in the variable rate positions and will not operate in the LINE lock position of the SWEEP TIME selector.

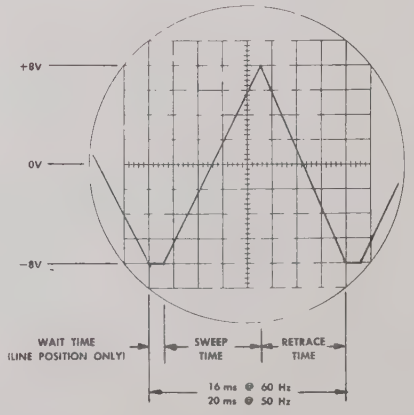


Figure 5-6. Scope Horizontal Output

5.3.13 Marker System Check

Connect the equipment as outlined in paragraph 5.3.1. The following check is for a harmonic marker. Specifications, with the exception of spurious markers, are the same for either single frequency or harmonic type markers and the procedure for verification of performance does not differ.

Single frequency markers should have no spurious markers throughout the swept range. Harmonic type markers may or may not have small spurious markers at one half or one third the specified marker interval.

MARKER SIZE
Observe the markers and ensure they are of equal amplitude throughout the range.

Set the oscilloscope vertical gain to .2 V/cm and adjust the MARKER SIZE control fully clockwise. The markers should be approximately 1V peak-to-peak in amplitude. Adjust the MARKERS SIZE control fully counterclockwise and set the oscilloscope vertical gain to 1mV/cm. The markers should be less than 1mV peak-to-peak in amplitude. Remove the sweep generator's bottom cover and position the marker CLAMP switch to its clamp position. (This slide switch is located directly behind the front panel DEMOD IN connector. Normal position is with slide lever toward center of instrument, the clamp position is with slide lever toward the right side panel.) Positive rectified markers should be present for use with X-Y recording instruments. The amplitude will be dependent on the output impedance of the RF detector being used. The amplitude should be adjustable from approximately 6V maximum to 1mV minimum with a detector impedance of 1 meg ohm, or from 0.5V to 1mV with a detector impedance of 0 ohms.
NOTE: The Sweep Width must be decreased or the Sweep Time increased to observe the rectified marker. Return the marker clamp switch to its normal position and replace the instrument's bottom cover.

MARKER TILT
Pull the pull/TILT switch out and set the MARKER SIZE control to minimum. A horizontal marker will be present having a fixed amplitude of approximately 10% of the total horizontal deflection. Increasing the MARKER SIZE control clockwise will add the normal vertical marker to the horizontal marker causing the marker to tilt toward a vertical position.

MARKER WIDTH
Return the pull/TILT switch to its "in" position. Turn on the 1 MHz markers and adjust the MARKER SIZE control to approximately a 4 cm peak-to-peak marker. Set the MARKER WIDTH selector to its widest position. Adjust the CENTER FREQUENCY and SWEEP WIDTH controls to calibrate the oscilloscope for a 1 MHz sweep width.

Adjust the CENTER FREQUENCY to center the birdy zero beat on the oscilloscope center graticule line and note that the marker width is approximately 400 kHz wide (each cm equals 100 kHz). Decrease the MARKER WIDTH switch one position and note that the marker is approximately 200 kHz wide. Decrease the MARKER WIDTH switch one position and note that the marker is approximately 100 kHz wide. Decrease the MARKER WIDTH switch to the most narrow position. The marker is now approximately 15 kHz wide.

MARKER ACCURACY
Marker accuracy may be verified by one of several methods. The first method requires a signal generator and a frequency counter covering the desired marker frequency. First adjust the Sweep Generator's Center Frequency to the markers frequency and the Sweep Width to approximately 2 MHz. Connect the output from the Signal Generator to the EXTERNAL MARKER jack, located on the Rear Panel, and carefully adjust the Sig-

nal Generator for a zero beat with the internally generated birdy marker. Next, connect the Signal Generator's output to the counter and read the signal generator frequency which is now identical to the internal markers frequency. Allowable error is 0.005% of the marker frequency. The second method uses the counter only but requires the removal of the instrument and marker module covers. Probe the marker box with the input lead from the counter until sufficient signal is picked up to provide a counter reading.

The highest crystal frequency used is approximately 50 MHz. Markers above this frequency use harmonics of the crystal frequency. Again the allowable error is 0.005% of the crystal frequency.

Test equipment for the marker accuracy check is not listed in the recommended test equipment chart since the requirements vary with the method and the specific markers installed in the unit. Also, the inherent stability of the quartz crystal makes a marker accuracy check unnecessary in all but the most critical applications.

5.3.14 External Programming

External programming inputs are not normally checked during incoming inspection unless these special functions are to be used in a particular application. The external programming circuits are covered in section 3 under Operating Instructions. If it is necessary to check these functions at incoming inspection, reference can be made to that section of the manual for complete set-up instructions.

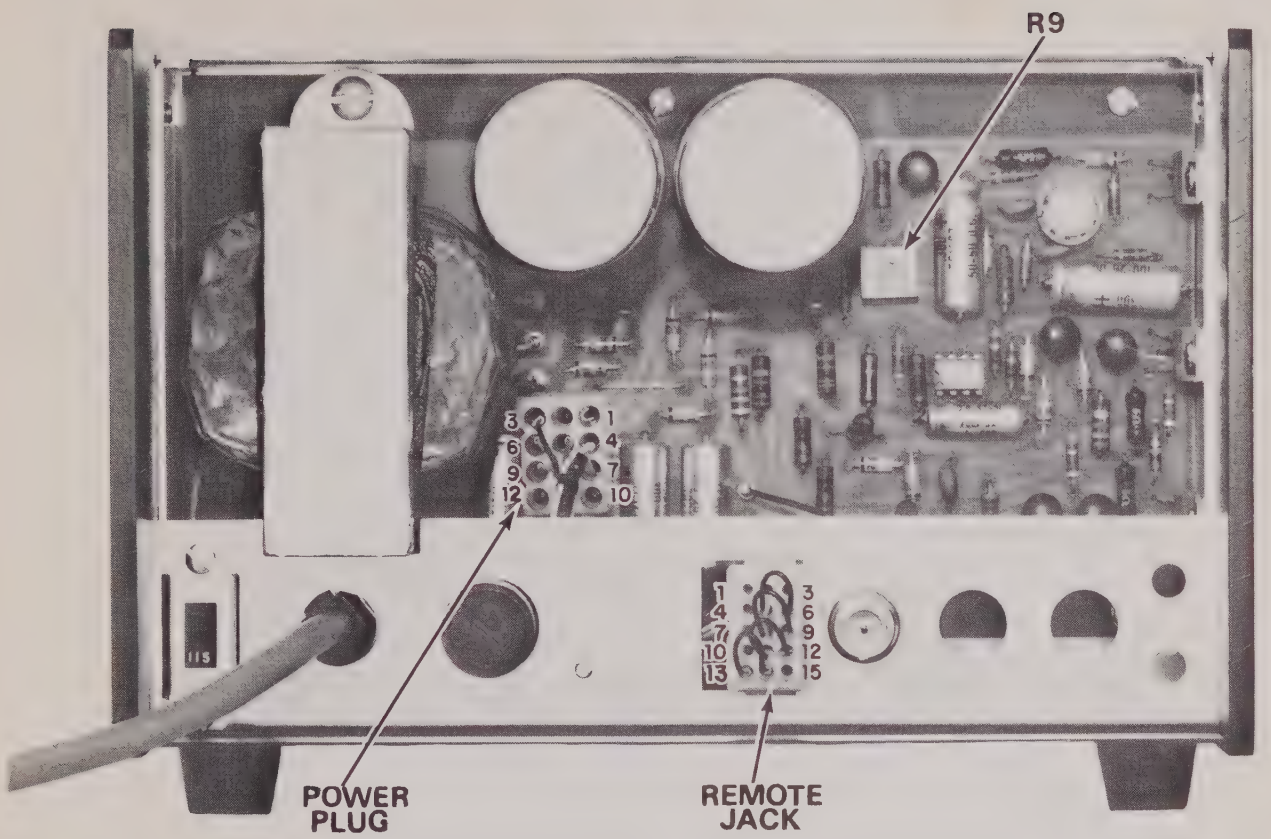


Figure 5-7. Power Supply

5.4 CALIBRATION PROCEDURE

Remove top cover, bottom cover, left side panel and M2J module cover. Allow a 15 minute warm-up period before calibrating.

In general, calibration must be performed in the sequence given. Refer to figure 5-7, 5-8, 5-9 and 5-14 for adjustment and test points.

5.4.1 +18 Volt Adjustment

Connect the digital voltmeter to the +18 volt supply, pin 6 on the power plug, and adjust resistor R9 to produce +18V. ±10mV. (See Figure 5-7).

5.4.2 -18 Volt Check

Connect the digital voltmeter to the -18 volt supply, pin 4 on power plug. The reading must be -18 volts, ±50mV.

5.4.3 -20 Volt Check

Connect the digital voltmeter to the-20 volt supply, pin 5 on the power plug. The reading must be -20 volts, ±0.3V.

5.4.4 -16 Volt Check

CAUTION: The + and -16 Volt supplies are not short circuit protected.

Connect the digital voltmeter to the -16 volt supply, pin 3 of the remote jack. It must read -16 volts, ±0.1 volt. (Record reading).

5.4.5 +16 Volt Adjustment

Connect the digital voltmeter to the +16 volt supply, pin 2 of the remote jack. Adjust R55 (see Figure 5-8) to obtain exactly the same voltage, but of opposite polarity, as recorded for the -16 volt supply in paragraph 5.4.4.

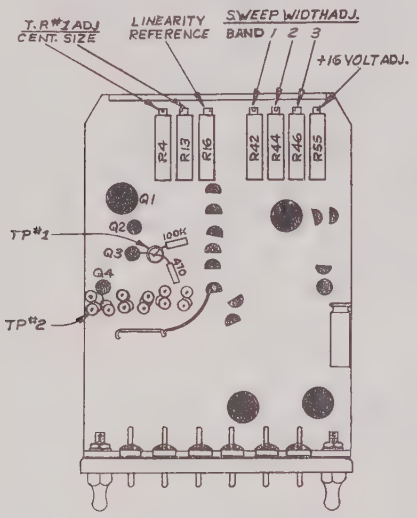


Figure 5.8. M2J

5.4.6 Sweep Rate Adjustments - Module M1H

Set Front Panel controls as shown in Figure 5-9. Connect the scope vertical input to the output of the rate generator, pin 10 of the REMOTE jack, and adjust the scope vertical and horizontal time base controls to produce a stable pattern similar to Figure 5-10. Adjust M1H CENT control to obtain an output symetrical about zero volts and the M1H SIZE control to obtain the 32 volt peak-to-peak amplitude.

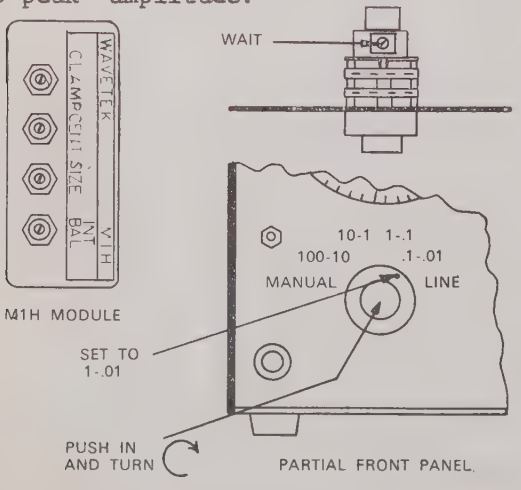


Figure 5-9. M1H Adjustments

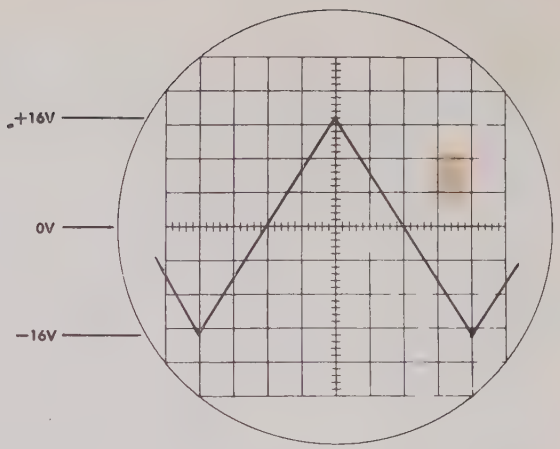


Figure 5-10. M1H Center and Size Adjustment

These adjustments should be made as precisely as possible. The + and -16 volt references available at pin 2 & 3 of the remote jack can be used to check the accuracy of the vertical calibration of the oscilloscope.

Next, set the Front Panel VAR/MANUAL control fully counterclockwise and adjust the M1H INT/BAL to produce a sweep time of 0.12 seconds. See Figure 5-11.

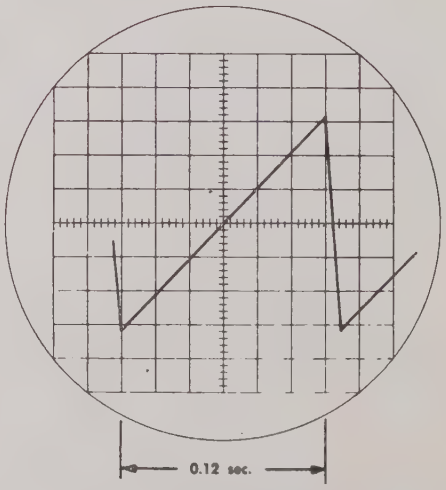


Figure 5-11. M1H Internal Balance Adjustment

Then set the Front Panel SWEEP TIME to LINE and adjust the M1H CLAMP control to clamp the negative going peak of the M1H output to -16 volts. See Figure 5-12.

Finally, adjust the WAIT control, mounted on rear of the SWEEP TIME switch assembly, (see Figure 5-9) until the wait time as shown in Figure 5-12 is approximately 1 millisecond.

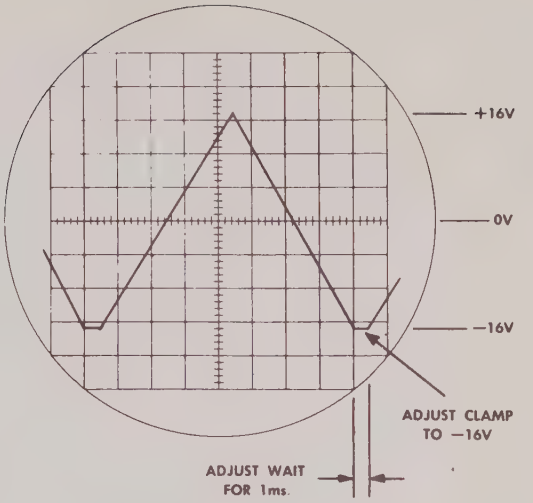


Figure 5-12. Sweep Ramp

5.4.7 Sweep Drive Adjustments - Module M2J

Connect the scope vertical input to test point #1 in the M2J module (see Figure 5-8). Set the Front Panel FREQUENCY control (coarse) to produce 0V at pin 6 of the module. The center frequency dial must read 250 MHz on the 0 to 500 MHz scale. If not, loosen the set screw holding the frequency dial to its shaft and reposition. Next, set the FREQUENCY (vernier) control to produce -8V at pin 8 of the module. The indicator line on the frequency (vernier) must be pointing toward the frequency indicator. If not, loosen screw and reposition. Next, set the Front Panel SWEEP WIDTH control completely counterclockwise, CW position, and adjust resistor R4 to produce 0V at test point #1. Next set the Front Panel SWEEP WIDTH control to maximum, completely clockwise, and the SWEEP WIDTH Range switch in the 500 MHz position, and adjust resistor R13 to produce a 28V peak-to-peak signal at test point #1.

Without disturbing the Front Panel CENT FREQ or SWEEP WIDTH adjustments, return the scope to an X-Y operating mode, with the HORIZ OUTPUT of the sweep generator driving the scope X input. Set the SWEEP TIME to .1-01 sec and adjust the SCOPE display width to 11cm (0.5cm overlap on each end). See Figure 5-13a.

Connect the scope "Y" input to M2J test point #2, which is the top side of any of the three diodes adjacent to M2J, Q4. (Linearity correcting resistors may or may not be connected to the diodes depending on the inherent linearity of the sweep oscillator). Adjust M2J resistor R16 to position the "knee" approximately 2/3cm to the left of the 10cm mark as shown in Figure 5-13b. The M2J cover and left side panel may now be replaced.

5.4.8 Level Min and Max Adjustments - Module M10H

Adjust the controls as follows: BAND to 0-500 MHz, FREQUENCY to 300 MHz, SWEEP WIDTH to "CW" position, completely counterclockwise, and OUTPUT to +10dBm. Set the power meter to +10dBm range and connect its thermistor mount to the RF OUTPUT connector.

Adjust the LEVEL MAX control, located on top of the M10H module, to provide a power meter reading of +10dBm. Next turn the OUTPUT vernier control completely counterclockwise to indicate -20dBm. Change the power meter range to -20dBm and adjust the LEVEL MIN control, lo-

cated on top of the M10H module to provide a power meter reading of -20dBm.

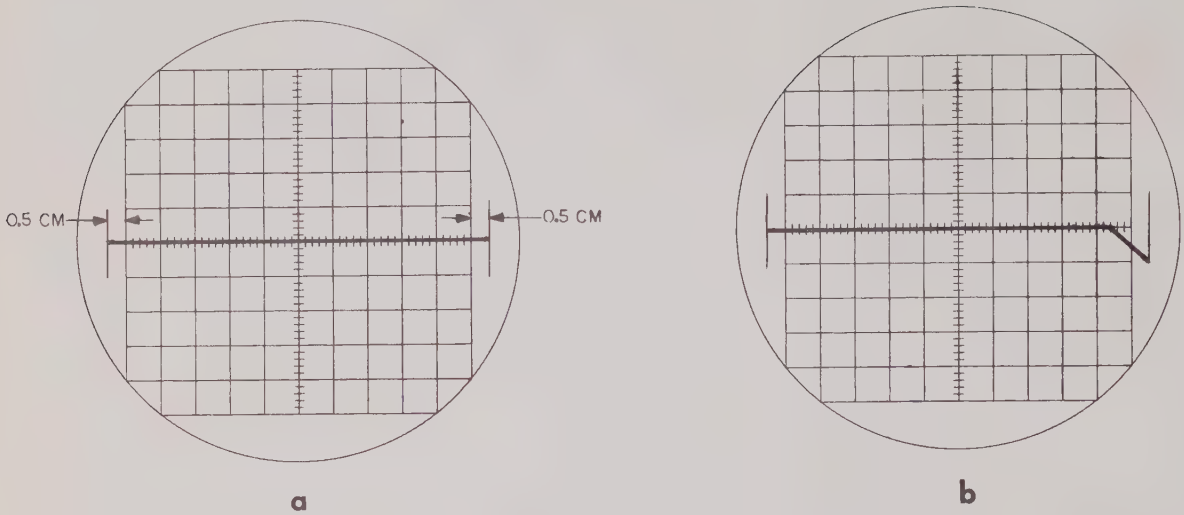


Figure 5-13. Linearity Ref Adjustment

5.4.9 Center Frequency Adjustment - Modules M9H & M19H

Connect the Sweep Generator, Scope and RF Detector as shown in the typical set-up, Figure 5-4. Pre-set the Front Panel controls as follows: Band to 0-500 MHz, FREQUENCY (coarse) to 250 MHz, FREQUENCY (fine) adjust line on control knob to point toward frequency indicator. Set the SWEEP WIDTH control to its maximum clockwise position. Set the RF Output controls for maximum output and the SWEEP TIME control to LINE position. Turn on the 50 MHz harmonic marker and adjust marker width to wide and marker size for a display similar to that of figure 5-5. Locate the harmonic marker corresponding to 250 MHz (count up from the zero lock-in point). Adjust the M9H CENT BAND 1 control to position this marker to the exact center of the display. Gradually reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M9H centering control to maintain the marker centered on the display.

Change the Band switch to 450 to 950 MHz. Return the sweep width control to maximum. Locate the 50 MHz Harmonic marker that corresponds to a frequency of 700 MHz. (Use a CW signal generator and the external marker circuit to identify the proper 50 MHz harmonic marker). Adjust the M19H CENT BAND 2 control to position the 700 MHz marker to the exact center of the display. Gradually reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M19H CENT BAND 2 control to maintain the marker centered on the display.

Change the BAND switch to 900 to 1400 MHz. Return the SWEEP WIDTH control to maximum. Locate the 50 MHz Harmonic Marker that corresponds to a frequency of 1150 MHz. (Use a CW signal generator and the external marker circuit to identify the proper 50 MHz harmonic marker). Adjust the M19H CENT BAND 3 control to position the 1150 MHz marker to the exact center of the display. Gradually reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M19H CENT BAND 3 control to maintain the marker centered on the display.

5.4.10 Sweep Width Adjustment - Module M2J

With the unit operating as set-up in paragraph 5.4.9, reposition the FREQUENCY (coarse) control to indicate 0 MHz. Make sure the FREQUENCY (fine) control is not disturbed. Return the

Front Panel SWEEP WIDTH control to its maximum clockwise position and adjust the M2J SWEEP WIDTH 1 to position the zero lock-in point to the center of the display. Reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M2J SWEEP WIDTH 1 control to maintain the zero lock-in point centered on the display.

Change the BAND switch to 450 to 950. Do not disturb the Coarse or Fine Frequency controls. Return the Front Panel SWEEP WIDTH control to maximum and locate the 50 MHz harmonic corresponding to 450 MHz. (Use an external CW signal generator and the external marker circuit to identify the proper 50 MHz harmonic.) Adjust the M2J SWEEP WIDTH 2 to position the 450 MHz marker to the center of the display. Reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M2J SWEEP WIDTH 2 control to maintain the 450 MHz marker centered on the display.

Change the BAND switch to 900 to 1400. Do not disturb the Coarse or Fine Frequency controls. Return the Front Panel SWEEP WIDTH control to maximum and locate the 50 MHz harmonic corresponding to 900 MHz. (Use an external CW signal generator and the external marker circuit to identify the proper 50 MHz harmonic). Adjust the M2J SWEEP WIDTH 3 to position the 900 MHz marker to the center of the display. Reduce the Front Panel SWEEP WIDTH control to minimum while readjusting the M2J SWEEP WIDTH 3 control to maintain the 900 MHz marker centered on the display.

5.4.11 Sweep Sample Adjustment - Module M5H

Connect the RF detector to the SWEEP SAMPLE OUT jack of the module, using the adapter cable supplied in the service kit, and adjust the SWEEP SAMPLE ADJ. to produce a detected output of approximately 35 millivolts.

5.4.12 Marker Size Adjustment - Module M6

Each marker module has a SIZE adjustment potentiometer which is accessible from the under side of the Sweep Generator when the bottom cover is removed. (See Figure 5-2.) The control is adjusted until a saturated marker is obtained on the scope display when operating the unit as shown in the typical set-up, Figure 5-4. A saturated marker is obtained when a further increase in the marker modules SIZE adjustment does not increase the marker amplitude on the scope display. Increasing the size adjustment beyond this point will result in spurious markers on the display.

5.5 TROUBLESHOOTING

Trouble shooting is generally a systematic procedure of "divide and conquer". A thorough understanding of the block diagram and circuit description located in Section 4 of this manual will enable the trouble symptom to be associated with a particular module. Once this has been accomplished the module can be replaced or trouble shot with the aid of the module schematic. A problem in a power supply often causes many symptoms pointing to other areas and should be checked when the symptom does not clearly indicate a specific problem. The +18, -18, and -20V supplies are located on the rear chassis printed circuit board and the +16 and -16 reference voltage supplies are located in the M2J module. Performance of these supplies are indicated in the calibration procedure.

5.5.1 Troubleshooting Hints

The following is a list of several typical symptoms followed by the probable cause or a troubleshooting procedure.

INTERMITTENT OPERATION OF ANY TYPE - Defective module, pin sockets, or loose RF cables.

NO RF OUTPUT

ALL THREE BANDS - Defective attenuator or RF cables connecting to the input or output of the attenuator.

SINGLE BAND ONLY -Check for the presence of the band switching voltages, B-1, B-2, and B-3 at module M9H, M10H, and M19H as shown on the Module Wiring Diagram.

RF OUTPUT NOT FLAT - Most common cause is the external RF detector being defective. Another is the monitor diode located in the M19H module. This is a point contact diode and can be damaged if the RF output is momentarily connected to a B+ voltage. A good monitor diode will produce a negative detected voltage (pin 8 of the M19H) approximately twice the amplitude of the external detector. For example, at an RF output of +10dBm an external RF detector will read approximately 0.8V. The internal monitor (pin 8 of M19H) will read approximately -1.6V.

FREQUENCY UNSTABLE (JITTER) - Check all modules for loose hold-down screws, especially module M2J. Check the + and -16V reference supplies. Operating the unit in a strong magnetic field, such as setting on top of or adjacent to another instrument containing a large power transformer, can produce 60 Hz HUM modulation.

SWEEP RATE PROBLEM - Probable cause is a defective M1H module or wiring to the Front Panel SWEEP TIME selector switch. See the calibration procedure for verifying proper operation.

NO RF SWEEP - First check pin 12 of the M1H module for the presence of a 32V ramp. This ramp indicates proper operation of the M1H. Next check for the ramp at the input of the M2J, pin 7. Finally check the output of the M2J at pin 9. It should be similar to the input except it will be lower in amplitude, approximately 12V peak-to-peak, and will have an average value of 0V when the Front Panel CENTER FREQUENCY control is set to mid-band. If the M2J output is correct the trouble would probably be in the M9H or M19H sweep oscillator module.

MARKER PROBLEMS

To isolate the cause of a marker problem when the symptom does not clearly indicate a specific circuit or component, first, with an RF detector, check the sweep sample output at the M5H Sweep Sample OUT connector. It should be a detected signal between 30 and 50mV. If the proper sweep sample signal is not present it indicates that the trouble is in the sweep oscillator module or connecting sweep sample cables.

Next, connect the detector in place of the terminating plug P102.

A signal at this point indicates all jumper cables and RF jacks on the M6 modules are intact. Then check for the birdy output at pin 3 of the marker module. A 10 to 15mV peak-to-peak birdy is sufficient to drive the M5H module and indicates the M6 module is operating properly. With the 15mV peak-to-peak birdy present at the input of M5H, pins 1, 2, 3 or 4, a 32V peak-to-peak signal will be produced at the output, pin 7. This indicates proper operation of the M5H. This output signal at pin 7 is controllable in width by the FRONT PANEL MARKER WIDTH control. The signal is now routed through the Front Panel MARKER SIZE control and to the Rear Panel SCOPE VERTICAL connector. A 1V peak-to-peak signal is normally at this point when the Front Panel SIZE control is set to maximum. A common marker problem is that caused by one of the interconnecting cables between the M6 modules being loose. This causes a notch in the sweep sample input to the module causing uneven or small markers.

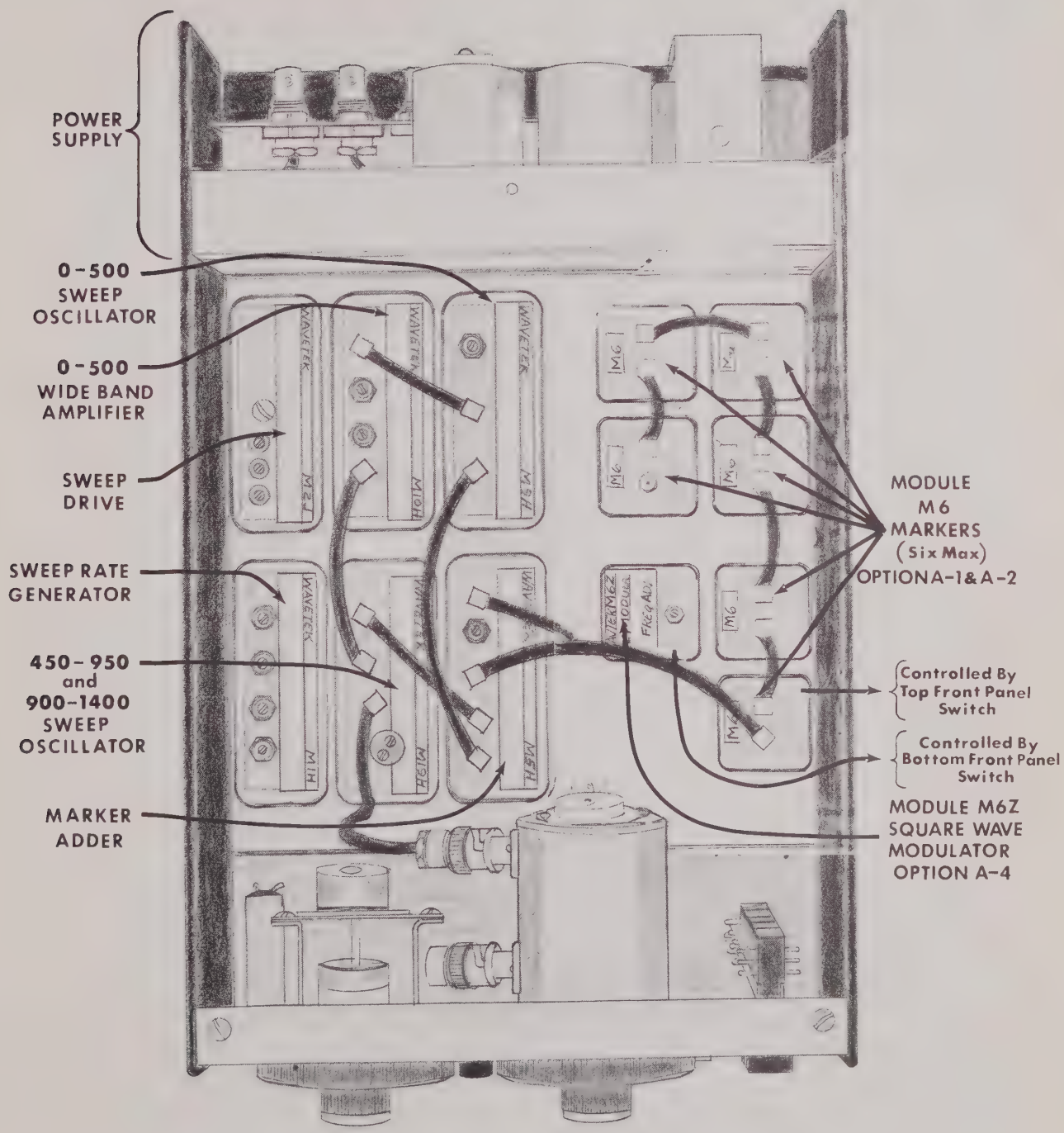

POWER SUPPLY
0-500 SWEEP OSCILLATOR
0-500 WIDE BAND AMPLIFIER
SWEEP DRIVE
SWEEP RATE GENERATOR
450-950 and 900-1400 SWEEP OSCILLATOR
MARKER ADDER
MODULE M6 MARKERS (Six Max) OPTION A-1 & A-2
Controlled By Top Front Panel Switch
Controlled By Bottom Front Panel Switch
MODULE M6Z SQUARE WAVE MODULATOR OPTION A-4

Figure 5-14. Model 2000 Top View

SECTION 6

SCHEMATICS AND PARTS LIST

6.1 INTRODUCTION — This section contains all schematics and a list of replaceable parts for the instrument. Parts lists are located on the reverse side of the associated schematics.

6.2 MANUFACTURER'S CODE — The following code is used on the parts list to identify the manufacturer.

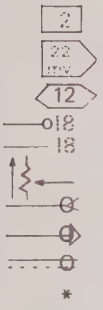
A-B	Allen-Bradley	Milwaukee, Wisconsin
A-E	Arco-Elmenco	Great Neck, New York
AER	Aerovox	New Bedford, Massachusetts
ALC	Alco Electronic Products Inc.	Lawrence, Massachusetts
AMP	AMP, Inc.	Harrisburg, Pennsylvania
APL	Amphenol	Danbury, Conn.
APX	Amperex	Slatersville, R. I.
BEK	Beckman Instruments, Inc.	Fullerton, California
BEL	Belden	Chicago, Illinois
BOU	Bourns	Riverside, California
BUS	Bussman	St. Louis, Missouri
CAM	Cambion	Cambridge, Massachusetts
C-D	Cornell Dubilier	Newark, New Jersey
CGW	Corning Glass Works	Corning, New York
C-J	Cinch Jones	Elk Grove Village, Illinois
C-K	C & K Components	Watertown, Massachusetts
C-L	Centralab	Milwaukee, Wisconsin
CTS	Chicago Telephone Systems	Elkhart, Indiana
C-W	Continental Wire	Philadelphia, Pennsylvania
DIO	Diodes, Inc.	Chatsworth, California
DRA	Drake Mfg. Company	Harwood Heights, Illinois
ETP	Erie Technological Prod. Inc.	Erie, Pennsylvania
FCD	Fairchild	Mountain View, California
G-E	General Electric	Syracuse, New York
G-H	Grayhill	La Grange, Illinois
HHS	Herman H. Smith, Inc.	Brooklyn, New York
H-P	Hewlett-Packard	Palo Alto, California
HEY	Heyman Mfg. Company	Kenilworth, New Jersey
IRC	International Resistance Co.	Philadelphia, Pennsylvania
ITT	International Telephone & Telegraph	West Palm Beach, Florida
JEF	Jeffers	Dubois, Pennsylvania
KID	Kidco, Inc.	Medford, New Jersey
LIT	Littelfuse	Des Plaines, Illinois
MAL	Mallory	Indianapolis, Indiana
M-O	Marko-Oak	Anaheim, California
MOL	Molex	Downers Grove, Illinois
MOT	Motorola	Phoenix, Arizona
P-B	Potter & Brumfield	Princeton, Indiana
POM	Pomona Electronics Co., Inc.	Pomona, California
Q-C	Quality Components	St. Marys, Pennsylvania
RCA	Radio Corporation of America	Harrison New Jersey

SCHEMATICS & PARTS LIST

RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Co.	St. Marys, Pennsylvania
SEL	Selectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
SIG	Signetics Corporation	Sunnydale, California
S-I	Switchcraft, Inc.	Chicago, Illinois
SPR	Sprague	North Adams, Massachusetts
S-T	Sarkes Tarzian	Bloomington, Indiana
STR	Stettner & Co.	Nurnburg, Western Germany
SYL	Sylvania	Woburn, Massachusetts
THR	Thermalloy, Co.	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
W-E	Wells Electronics	South Bend, Indiana
W-I	Wavetek, Indiana, Inc.	Indianapolis, Indiana
WSD	Wavetek, San Diego	San Diego, California

6.3 SCHEMATIC NOTES — The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

All resistor values are shown in "ohms" unless otherwise specified.
All capacitor values are shown in picofarads "pF" unless otherwise specified.
All inductor values are shown in microhenries "uH" unless otherwise specified.



Denotes DC voltage reading in volts unless otherwise specified.
Denotes high impedance crystal detector reading in volts unless otherwise specified.
Denotes 50ohm crystal detector reading in volts unless otherwise specified.
Signal or voltage source
Connect to indicate signal or voltage source
Arrow indicates clockwise rotation of wiper
Coaxial jack
Coaxial plug
Coaxial cable
* Factory adjusted part

6.4 ABBREVIATION CODE

A	ampere	IF	intermediate frequency	Ω	ohm
ac	alternating current	kHz	kiloherz	p-p	peak to peak
C	capacitor	Kohm	kilohm	pF	picofarad
CR	diode	kv	kilovolt	Q	transistor
dB	decibel	kW	kilowatt	R	resistor
dBm	decibel referred to 1mW	L	inductor	RF	radio frequency
dc	direct current	MHz	megahertz	rms	root-mean-square
DS	device indicating, lamp	Mohm	megohm	R.P.	rear panel
F	farad	uF	microfarad	S	switch
F.P.	front panel	uA	microampere	T	transformer
H	henry	uH	microhenry	V	volt
Har	harmonic	mA	milliampere	VA	voltampere
Hz	hertz	mH	millihenry	W	watt
IC	integrated circuit	mV	millivolt	X	crystal
		mW	milliwatt		

SCHEMATIC, PS6 POWER SUPPLY

REV. D

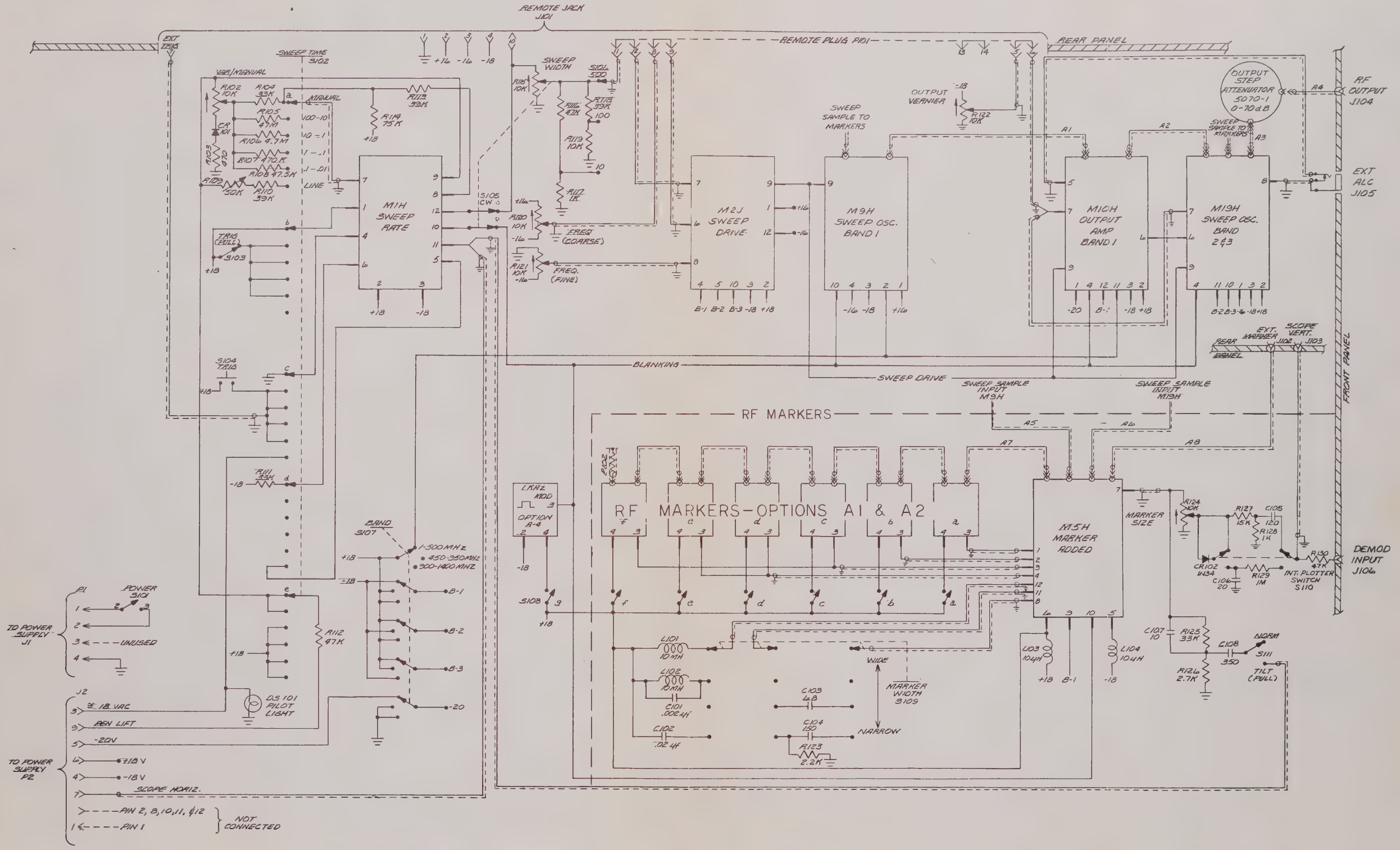
PARTS LIST PS6 POWER SUPPLY REV. D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
	----------PARTS MOUNTED ON PRINTED CIRCUIT BOARD ----------				
"C "	CAPACITORS				
1,7	Electrolytic, 1250uF, 50V	CE114-212	SPR	PCL-1339	2
2	Electrolytic, 50uF, 50V	CE107-050	SPR	TE1307	1
3,6,10,11	Electrolytic, 100uF, 25V	CE105-110	SPR	TE1211	4
4,12	Ceramic disc., 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	2
5	Ceramic disc., .005uF ±20%	CD103-250	SPR	TG-D50	1
8	Ceramic disc., 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
9	Electrolytic, 10uF, 25V	CE105-010	SPR	TE1204	1
"P "	CONNECTORS (PLUGS)				
2	12-pin printed circuit	MC000-031	MOL	03-04-4121	1
"CR "	DIODES				
1 to 17	Silicon, junction, 100piV, 3/4A	DR000-001	ITT	1N4002	17
"IC "	INTEGRATED CIRCUITS				
1	Voltage Regulator, 10 pin TO-5	IC000-001	FCD	U5R7723393	1
2	Operational amplifier, 8 pin in line	IC000-002	SIG	N5741V	1
"R "	RESISTORS				
1	Fixed, comp., 270ohm ±10% ¼W	RC104-127	A-B	CB2711	1
2	Fixed, comp., 1.8k ±10% ¼W	RC104-218	A-B	CB1821	1
3,11,22	Fixed, deposited carb., 5ohm ±1% ¼W	RD0R-050	K1D	K-C¼	3
4,14,21	Fixed, deposited carb. 1k ±1% ¼W	RD011-100	COR	RN60D	3
5	Fixed, deposited carb., 12.1k ±1% ¼W	RD012-121	COR	RN60D	1
6	Fixed, comp., 1.5k ±10% ¼W	RC104-215	A-B	CB1521	1
7	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	1
8	Fixed, comp., 3.9k ±5% ¼W	RC103-239	A-B	CB3925	1
9	Variable, cermet, 1k ±20%	RP131-210	CTS	360T102B	1
10	Fixed, comp., 2.7k ±5% ¼W	RC103-227	A-B	CB2725	1
12,25	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	2
13	Fixed, comp., 2.7k ±10% ½W	RC106-227	A-B	EB2721	1
15,24	Fixed, deposited carb., 15k ±1% ¼W	RD012-150	COR	RN60D	2
16,17	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	2
18	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	1
19,20	Dep. carb., 10k, matched set, ±.1%	RX000-003	W-I	RX000-003	1
23,29	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	2
26	Fixed, comp., 2.2k ±10% ½W	RC106-222	A-B	EB2221	1
27	Fixed, deposited carb., 825ohm ±1% ¼W	RD010-825	COR	RN60D	1
28	Fixed, deposited carb., 6.81k ±1% ¼W	RD011-681	COR	RN60D	1
30	Fixed, comp., 470ohm ±10% ½W	RC106-147	A-B	EB4711	1
31	Fixed, comp., 220ohm ±10% ½W	RC106-122	A-B	EB2211	1
"T "	TRANSFORMERS				
1	115/230 X 48 Vac, center tapped	TT000-022	W-I	TT000-022	1

PARTS LIST PS6 POWER SUPPLY REV. D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,4,5,9,10	PNP, Silicon	QA036-440	FCD	2N3644	5
2,3,8	NPN, Silicon	QA052-940	RCA	2N5294	3
6,7,11,12	NPN, Silicon	QA038-541	G-E	2N3854A	4
	---------- PARTS MOUNTED ON CHASSIS, AND MISCELLANEOUS PARTS ----------				
"J "	CONNECTORS (JACKS)				
1	4-pin receptacle	MC000-034	MOL	1625-4R-1	1
----	Contact, female, for above	MC000-018	MOL	1855	4
4	BNC, receptacle	JB109-111	APL	UG911A/I	1
"P "	CONNECTORS (PLUG)				
3	AC Plug/cord assembly (USA-Canada)	WL002-088	BEL	17237	1
	AC Plug/cord assembly (Western Europe)	WL007-088	BEL		
"F "	FUSES				
1	.5 Amp., slo-blo (used with 115Vac line)	MF000-007	BUS	MDV½	1
	.25Amp., slo-blo (used with 230Vac line)	MF000-006	BUS	MDV¼	--
	Fuse holder, for above	MF000-001	BUS	HMM	1
"S "	SWITCHES				
1	DPDT, slide, power change	SS000-003	S-I	46256LFE	1
	MISCELLANEOUS				
	Bushing, strain relief	HB004-000	HEY	SR5P1	1
	10 lead, TO-5 pad	HQ103-000	THR	7717-21DAP	1
	Insulated sholder washer	HW110-400	RCA	DF137A	3
	Transistor mtg. insulator, mica	HQ101-003	W-I	HQ101-003	3
	---------- PARTS FOR PEN LIFT OPTION A5 ----------				
"J "	CONNECTORS (JACKS)				
50,51	Binding post, miniature, .104ID (mates with wire, or banana plug)	MC000-038	POM	2439	2
"K "	RELAYS				
50	SPST, N.O. 12V	MR000-001	P-B	JRM1006	1

MODULE WIRING DIAGRAM
2000 HEAD
REV. A



PARTS LIST MODEL 2000 HEAD REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
	STANDARD MODULES				
M1H	Sweep Rate Module	M1H	W-I	M1H	1
M2J	Sweep Drive Module	M2J	W-I	M2J	1
M5H	Marker Adder Module	M5H	W-I	M5H	1
M9H	Oscillator/Mixer Module, Band 1	M9H	W-I	M9H	1
M10H	Output Amplifier Module, Band 1	M10H	W-I	M10H	1
M19H	Oscillator Module, Band 2 & 3	M19H	W-I	M19H	1
	OPTIONS				
A1	Single frequency marker, 1 to 1400 MHz (specify frequency)	M6S	W-I	M6S	-
A2	Harmonic markers 1, 10 & 50 MHz (specify frequency)	M6H	W-I	M6H	-
A4	1 kHz Square Wave Modulation	M6Z	W-I	M6Z	-
A5	(See Power Supply Parts List)	---	---	---	-
"A ____"	ASSEMBLIES				
1	RF Cable, 50 ohm	WX2000-A1	W-I	WX2000-A1	1
2	RF Cable, 50 ohm	WX2000-A2	W-I	WX2000-A2	1
3	RF Cable, 50 ohm	WX2000-A3	W-I	WX2000-A3	1
4	RF Cable, 50 ohm	WX2000-A4	W-I	WX2000-A4	1
5	RF Cable, 50 ohm	WX2000-A5	W-I	WX2000-A5	1
6	RF Cable, 50 ohm	WX2000-A6	W-I	WX2000-A6	1
7	RF Cable, 50 ohm	WX2000-A7	W-I	WX2000-A7	1
8	RF Cable, 50 ohm	WX2000-A8	W-I	WX2000-A8	1
-----	S102 Assembly with Associated Parts	B500-227	W-I	B500-227	1
-----	S108 Assembly with Associated Parts	B500-181	W-I	B500-181	1
5070-1	RF Attenuator	5070-1	W-I	5070-1	1
"C ____"	CAPACITORS				
101	Ceramic disc, .002uF +10% 1kV	CD102-220	SPR	5GAD20	1
102	Ceramic disc, .02uf +10% 100V	CD103-320	SPR	TGS20	1
103	Ceramic disc, 68pF +5% 1kV	CD104-068	SPR	10TCU	1
104	Ceramic disc, 150pF +20% 1kV	CD102-115	SPR	5GAT15	1
105	Ceramic disc, 120pF +20% 1kV	CD102-112	SPR	5GAT12	1
106	Ceramic disc, 20pF +5% 1kV	CD101-020	SPR	10TCCQ20	1
107	Ceramic disc, 10pF +5% 1kV	CD101-010	SPR	10TCCQ10	1
108	Ceramic disc, 350pF +20% 1kV	CD102-135	SPR	5GAT35	1
"J ____"	CONNECTORS (JACKS)				
2	12-pin receptacle	MC000-030	MOL	1360-R1	1
	Contact, female, for above	MC000-032	MOL	1433	6
	Contact, male, for above	MC000-033	MOL	1434	1
101	15-pin receptacle	MC000-016	MOL	1625-15R	1
	Contact, female, for above	MC000-018	MOL	1855	14
102,103,104	BNC, Cable	JB000-003	W-I	JB000-003	3
105	Phone, receptacle, submin. (mates with Switchcract "750" plug)	MC000-036	S-I	142A	1
106	BNC, receptacle	JB109-111	APL	UG911A/U	1
----	Pin Socket, Teflon	MC000-002	W-I	MC000-002	-

PARTS LIST MODEL 2000 HEAD REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"P ____"	CONNECTORS (PLUGS)				
1	4-pin	MC000-035	MOL	1625-4P1	1
	Contact, male, for above	MC000-019	MOL	1854	4
101	15-pin	MC000-018	MOL	1625-15P	1
	Contact, male, for above	MC000-019	MOL	1854	8
102	Termination	JF000-010	W-I	JF000-010	1
"CR ____"	DIODES				
101	Silicon, junction, 100piV, 750 mA	DR000-001	ITT	1N4002	1
102	Germanium, point contact	DG100-341	SYL	1N34AS	1
"DS ____"	LAMPS				
101	Indicator, Incadescent	MB00-0003	M-O	99-33080	1
"L ____"	INDUCTORS				
101,102	Fixed, 10mH	LA104-310	JEF	15S	2
103,104	Fixed, 10uH	LA101-010	JEF	15	2
"R ____"	RESISTORS				
102	Variable, 10k ohm, part of S103 assembly	---------	---	----	-
103	Fixed, comp., 470 ohm +5% ¼W	RC104-147	A-B	CB4715	1
104,111	Fixed, comp., 33k ohm +5% ¼W	RC103-333	A-B	CB3335	2
105	Fixed, comp., 47M ohm +5% ¼W	RC103-647	A-B	CB4765	1
106	Fixed, comp., 4.7M ohm +5% ¼W	RC103-547	A-B	CB4755	1
107	Fixed, comp., 470k ohm +5% ¼W	RC103-447	A-B	CB4745	1
108	Fixed, metal film, 47.5k ohm +1% ½W	RF012-475	COR	RN60D	1
109	Variable, cermet, 50k ohm +20% 1W	RP129-350	CTS	360S503B	1
110,113,118	Fixed, comp., 39k ohm +5% ¼W	RC103-339	A-B	CB3935	2
112,116	Fixed, comp., 47k ohm +5% ¼W	RC104-347	A-B	CB4735	1
114	Fixed, comp., 75k ohm +5% ¼W	RC103-375	A-B	CB7535	1
115	Variable, carbon 10k ohm	RP132-310	W-I	RP132-310	1
117	Fixed, comp., 1k ohm +5% ¼W	RC103-210	A-B	CB1025	1
119	Fixed, comp., 10k ohm +5% ¼W	RC103-310	A-B	CB1035	1
120	Varible, carbon 10k ohm	RP900-004	W-I	RP900-004	1
121	Variable, carbon 10k ohm	RP123-310	W-I	RP123-310	1
122	Variable, carbon 10k ohm	RP128-310	W-I	RP128-310	1
123	Fixed, comp., 3.3k ohm +10% ¼W	RC104-222	A-B	CB2221	1
124	Variable, carbon 10k ohm, part of S107	---------	---	------	-
125	Fixed, comp., 33k ohm +10% ¼W	RC104-333	A-B	CB3331	1
126	Fixed, comp., 2.7k ohm +10% ¼W	RC104-227	A-B	CB2721	1
127	Fixed, comp., 15k ohm +10% ¼W	RC104-315	A-B	CB1531	1
128	Fixed, comp., 1k ohm +10% ¼W	RC104-210	A-B	CB1021	1
129	Fixed, comp., 1M ohm +10% ¼W	RC104-510	A-B	CB1051	1
130	Fixed, comp., 47k ohm +10% ¼W	RC104-347	A-B	CB4731	1
"S ____"	SWITCHES				
101	SPDT	ST000-007	W-I	ST000-007	1
102	Rotary, 6-pole, 6-position, assembly	SR000-019	W-I	SR000-019	1
103	SPST, Push on, (part of S102 assembly)	---------	---	---------	-
104	Momentary contact N.O. submin	SM000-004	G-H	39-1	1
105	DPST, Rotary, (part of R115)	---------	MAL	U27	1

PARTS LIST MODEL 2000 HEAD REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"S ____"	SWITCHES				
106	2-pole, 3-position slide, submin.	SS000-004	C-W	G128	1
107	Rotary, 6-pole, 3-position	SR000-020	OAK	399646-512	1
108	Push-button switch assembly	SZ000-004	W-I	SZ000-004	1
109	Rotary, 6-pole, 4-position assembly	SR000-018	W-I	SR000-018	1
110	DPDT, Slide, subminiature	SS000-001	C-W	G126	1
111	SPST, Push-off (part of S107 assembly)	---------	---	---------	-
SEE FIG. 3-1	MISCELLANEOUS MECHANICAL				
1	Knob, 1/2" dia. with pointer	KK000-020	BUK	PS50PL-1	2
2	Knob, must be calibrated	---------	---	--------	1
2	Knob, 7/8" dia. and cap	KK300-761	W-I	KK300-761	1
3	Knob, engraved +10-60dBm	KK319-101	W-I	KK319-101	1
4	Knob, must be calibrated	---------	---	---------	1
5	Push button, black, plain	SZ000-007	C-L	J52304B	-
7,10	Knob, 7/8" dia.	KW103-309	WDS	130-309	2
7,10	Knob	KK200-762	W-I	KK300-762	2
9	Knob, 7/8" dia.	KW130-314	WDS	130-314	1

SWEEP RATE SCHEMATIC
MODULE M1H REV. A

+18 R1 220 +18
R2 4.7K R3 4.7K
INTEGRATOR INPUT Q1/Q2 MATCHED SET
C1 6.8
R4 47K R5 4.7K R6 180K +18 R7 20K INT BAL
-18
Q3 MPS 3702 R55 6.8K
CR1 PIV100 C2 470 R57 47
Q4 MPS3702
R8 22K R9 220 C21 .01μF
C3 .15μF*
2N5458 Q5
C5 .001μF R21 18K
R10 5.6M C4 10
R54 27K R20 20K CLAMP R22 62K +18
CLAMP LEVEL SHIFT R19 100K
C8 6.8
CR2 PIV100 +18 Q8 MPS3702
R24 100K R23 560K R25 1M -18
Q9 MPS3702 CR9 PIV100
R28 100K Q11 MPS3702
R29 100K R26 22K 2N3854A Q10 R27 22K
R30 10K
C10 .02μF R33 47K C11 470
TRIGGER INPUT C9 6.8
R31 10K -18 Q12 2N3854A R32 1K Q13 2N3854A
CR3 PIV100
R34 10M Q14 2N5458
TRIGGER ROUTING C12 6.8 6

+18 R13 47K R14 4.7K Q6 TD101 R11 4.7K
C6 470 R16 10K R51 10K R15 68K -18
+18 R12 47 Q7 MPS3702 CR8 PIV100
R18 47K R53 47K
Q19 MPS3702 R17 10K R52 100
SWEEP DRIVE OUTPUT ∧32VP-P C20 6.8 12
SCOPE HORIZ. OUTPUT ∧16VP-P C7 6.8 11
INTEGRATOR OUTPUT C14 6.8 8
R44 12K R45 20K SIZE R46 39K
HYSTERESIS SWITCH OUTPUT C15 6.8 9
+18 R35 100
R36 22K R37 4.7K Q16 MPS3702
C13 120
Q15 TD101 +18 R40 220K R41 20K CENT R39 47K R38 47K -18
CR4 PIV100 CR5 PIV100 CR6 PIV100
R48 10K +18 R49 470 Q18 2N3854A CR7 PIV100 C16 6.8 10
BLANKING OUTPUT ⎍ -1 TO +14V
Q17 MPS3702 R50 15K R56 27K -18 -18
R42 6.8K R43 100 R47 220K
TRIGGER OUTPUT C17 6.8 5
-18 +18
C18 470 C19 470
3 2
-18 15/22 MA +18 10/20MA

✡ = CONNECTED TO SWEEP TIME SWITCH

PARTS LIST — MODULE M1H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,7,8,9 12,14,15 16,17,20	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	10
2,6,11	Ceramic disc, 470pF, ±20% 1KV	CD102-147	SPR	5GAT47	3
3	Mylar paper, 15uF ±10% 100V	CP103-415	C-D	WMF1P15	1
4	Ceramic disc, 10pF ±5% 1KV	CD101-010	SPR	10TCCV10	1
5	Ceramic disc, .001uF ±20% 1KV	CD102-210	SPR	5GA010	1
10	Ceramic disc, .02uF ±20% 100V	CD103-320	SPR	TGS20	1
13	Ceramic disc, 120pF ±20% 1KV	CD102-112	SPR	5GAT12	1
18,19	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	2
21	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TGS10	1
"CR "	DIODES				
1,2,3,4,5 6,7,8,9	Silicon, junction, 100PIV, 750mA	DR000-001	ITT	1N4002	9
"R "	RESISTORS				
1,9	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	2
2,3,5,11 14,37	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	6
4,13,18,33 38,39,53	Fixed, comp., 47k ±10% ¼W	RC104-347	A-B	CB4731	7
6	Fixed, comp., 180k ±10% ¼W	RC104-418	A-B	CB1841	1
7,20,41,45	Variable, carbon, 20k ±20%	RP124-320	A-B	WA2G032	4
8,26,27,36	Fixed, comp., 22k ±10% ¼W	RC104-322	A-B	CB2231	4
10	Fixed, comp., 5.6M ±10% ¼W	RC104-556	A-B	CB5651	1
12,57	Fixed, comp., 47ohm ±10% ¼W	RC104-047	A-B	CB4701	2
15	Fixed, comp., 68k ±10% ¼W	RC104-368	A-B	CB6831	1
16,51	Fixed, comp., 10k ±5% ¼W	RC103-310	A-B	CB1035	2
17,30,31,48	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	4
19,24,28,29	Fixed, comp., 100k ±10% ¼W	RC104-410	A-B	CB1041	4
21	Fixed, comp., 18k ±10% ¼W	RC104-318	A-B	CB1831	1
22	Fixed, comp., 62k ±5% ¼W	RC103-362	A-B	CB6235	1
23	Fixed, comp., 560k ±10% ¼W	RC104-456	A-B	CB5641	1
25	Fixed, comp., 1M ±10% ¼W	RC104-510	A-B	CB1051	1
32	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	1
34	Fixed, comp., 10M ±10% ¼W	RC104-610	A-B	CB1061	1
35,43,52	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
40,47	Fixed, comp., 220k ±10% ¼W	RC104-422	A-B	CB2241	2
42,55	Fixed, comp., 6.8k ±10% ¼W	RC104-268	A-B	CB6821	2
44	Fixed, comp., 12k ±10% ¼W	RC104-312	A-B	CB1231	1
46	Fixed, comp., 39k ±10% ¼W	RC104-339	A-B	CB3931	1
49	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
50	Fixed, comp., 15k ±10% ¼W	RC104-315	A-B	CB1531	1
54,56	Fixed, comp., 27k ±10% ¼W	RC104-327	A-B	CB227	2

PARTS LIST — MODULE M1H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,2	N-channel JFET'S, matched pair	QB000-014	W-I	QB000-014	1
3,4,7,8,9 11,16,17,19	PNP, Silicon	QB000-009	MOT	MPS3702	9
5,14	N-channel, Silicon, JFET	QA054-580	MOT	2N5458	2
6,15	Dual, NPN, Silicon	QB000-010	SPR	TD101	2
10,12,13,18	NPN, Silicon	QA038-541	G-E	2N3854A	4

SWEEP DRIVE SCHEMATIC
MODULE M2J

REV 8

TUNING AND SWEEP PROGRAMS

C1 6.8 (6) · C2 6.8 (7) · C3 6.8 (8)

R1 178K ‡ · C22 3.9 · R2 178K ‡ · C23 3.9 · R3 2.2M ‡

Q1 TO101 · Q2 2N4250 · Q3 2N4250 · Q4 2N4250

R4 20K · R5 470K · R6 4.7K · R7 8.2K * · R8 47K · R9 100 · R10 10K · R11 100 · R12 82K · R13 20K · R14 10K · R15 470 · R16 20K · R17 4.7K · R18 4.7K · R19 4.7K · R20 2.2K · R21 2.2K · R22 2.2K · R23 2.2K

C4 15 · C5 2.4 · CR1

CR2 * · CR3 * · CR4 * · CR5 * · CR6 * · CR7 * · CR8 * · CR9 * · CR10 * · CR11 * · CR12 *

+18 · +16 · -16 · -18

R24 100K · Q5 2N5461 · R25 10M · Q6 2N5461 · R26 10M · Q7 2N5461 · R27 10M

B-1 · B-2 · B-3

R30 47K · Q8 TO401 · R32 10K · R33 10 · Q10 2N5088 · R34 47 · C6 25 · CR13 · Q9 2N5088 · R29 4.7K · R31 27K · R28 10 · C7 3.9

C17 6.8 (9) SWEEP DRIVE OUTPUT

R36 18K · R37 18K · R38 18K · R40 10M · Q13 2N5461 · R39 10M · Q12 2N5461 · R35 10M · Q11 2N5461

R45 4.7K · R46 20K SWEEP WIDTH3 · R43 4.7K · R44 20K SWEEP WIDTH2 · R41 4.7K · R42 20K SWEEP WIDTH1

C18 470 (1) +16 VOLT SUPPLY

C19 470 (12) -16 VOLT SUPPLY

R56 8.2K · R57 21.5K ‡ · R58 19.1K ‡ · C14 10µF · Q17 TO401 · R61 15K · C16 .01µF · C15 470 · Q19 MPS3702 · Q18 2N5088 · R60 560 · R59 470 · CR16 · CR17 · R62 4.7

R47 470 · CR14 · CR15 · R50 4.7 · R49 560 · Q15 2N4250 · C12 470 · R51 15K ‡ · C13 .01µF · Q16 2N5088 · C11 10µF · R52 10K ‡ · R53 10K ‡ · R54 1.2M · R55 20K · Q14 TO101 · R48 8.2K

C8 470 (10) B-3 · C9 470 (4) B-1 · C10 470 (5) B-2

C20 470 (3) -18V 27MA · C21 470 (2) +18V 27MA

+7 -5

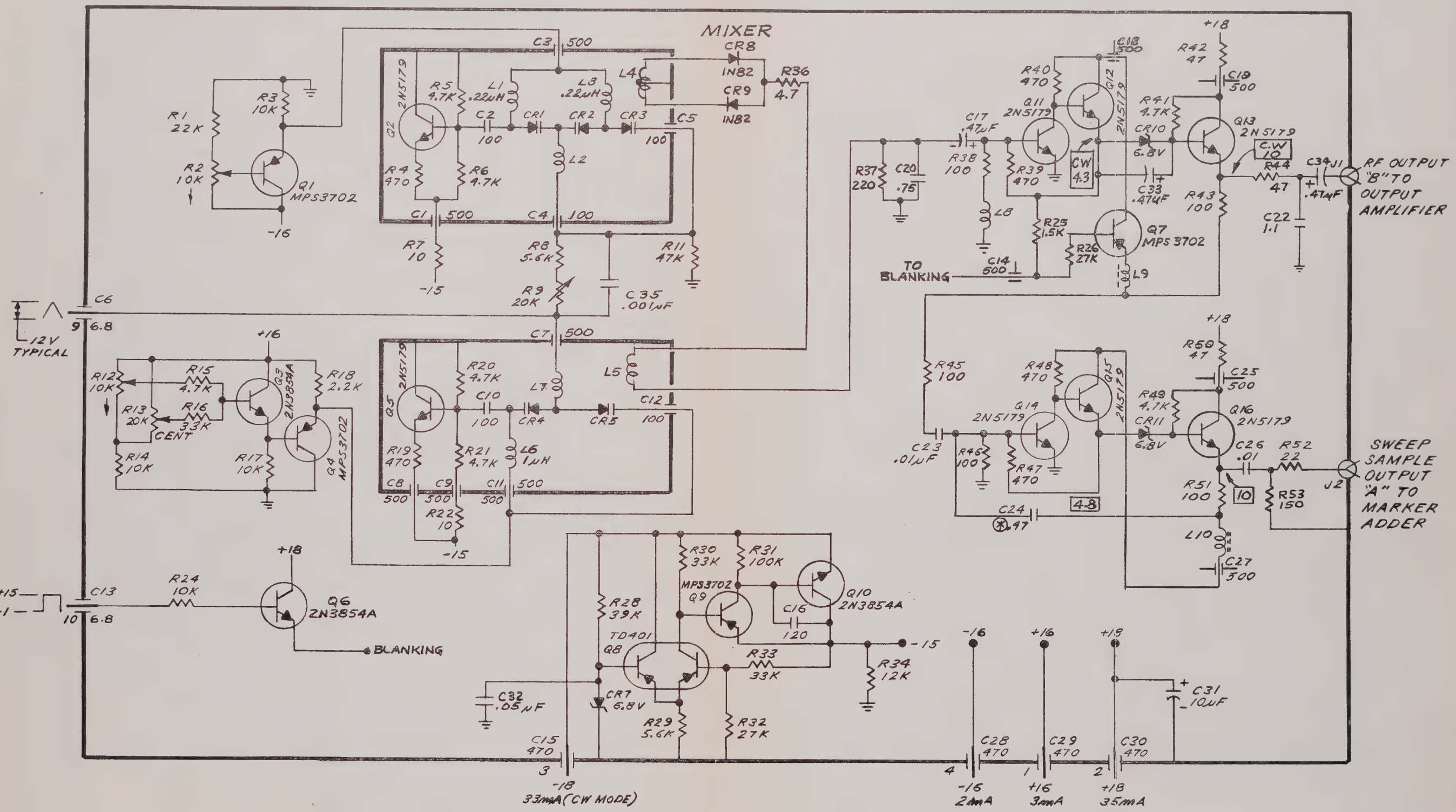
‡ MATCHED

PARTS LIST — MODULE M2J REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
" C "	CAPACITORS				
1,2,3,17	Ceramic feedthru, 6.pF ± 10% 500V	CF-102-R68	A-B	FA5C	4
4	Ceramic disc., 15 pF ± 5% 1kV	CD-101-015	SPR	10TCC-Q15	1
5	Composition 2.4pF ± 10% 500V	CG-101-224	Q-C	QC2.4	1
6	Ceramic disc., .25pF ± 5% 1kV	CD-101-025	SPR	10TCC-Q25	1
7,22,23	Composition 3.9pF ± 10% 500V	CG-101-239	Q-C	QC3.9	3
8,9,10,18 19,20,21	Ceramic feedthru, 470pF ± 20% 500V	CF-101-147	A-B	FA5C	7
11,14	Electrolytic, 10uF, 25V	CE-105-010	SPR	TE1204	2
12,15	Ceramic dis., 470pF ± 20% 1kV	CD-102-147	SPR	5GAT47	2
13,16	Ceramic disc., .01uF ± 20% 100V	CD-103-310	SPR	TGS10	2
" CR "	DIODES				
1 to 17	Silicon, Junction 100piV, 750mA	DR-000-001	ITT	1N4002	17
" R "	RESISTORS				
1,2	Deposited carb. 178 k, matched set .1%	RX-000-005	W-I	RX-000-005	1
3	Fixed, comp., 2.2M ohm ± 5% ¼W	RC-103-522	A-B	CB2255	1
4,13,16,42 44,46.55	Variable, cermet, 20k ohm± 10% 3/4W	RP-130-320	BEK	89PR20K	7
5	Fixed, comp., 470k ohm ± 10% ¼W	RC-104-447	A-B	CB4741	1
6,17,18,19 29,41,43,45	Fixed, comp., 4.7k ohm ± 10% ¼W	RC-104-247	A-B	CB4721	8
7,48,56	Fixed, comp., 8.2k ohm ± 10% ¼W	RC-104-282	A-B	CB8221	3
8,30	Fixed, comp., 47k ohm ± 10% ¼W	RC-104-347	A-B	CB4731	2
9,11	Fixed, comp., 100 ohm ± 10% ¼W	RC-104-110	A-B	CB1011	2
10,14,32	Fixed, comp., 10k ohm ± 10% ¼W	RC-104-310	A-B	CB1031	3
12	Fixed, comp., 82k ohm ± 10% ¼W	RC-104-382	A-B	CB8231	1
15,47,59	Fixed, comp., 470 ohm ± 10% ¼W	RC-104-147	A-B	CB4711	3
20,21,22,23	Fixed, comp., 2.2k ohm ± 10% ¼W	RC-104-222	A-B	CB2221	4
24	Fixed, comp., 100k ohm ± 10% ¼W	RC-104-410	A-B	CB1041	1
25,26,27,35 39,40	Fixed, comp., 10M ohm ± 10% ¼W	RC-104-610	A-B	CB1061	6
28,33	Fixed, comp., 10 ohm ± 10% ¼W	RC-104-010	A-B	CB1001	2
31	Fixed, comp., 27k ohm ± 10% ¼W	RC-104-327	A-B	CB2731	1
34	Fixed, comp., 47 ohm ± 10% ¼W	RC-104-047	A-B	CB4701	1
36,37,38	Fixed, comp., 18k ohm ± 10% ¼W	RC-104-318	A-B	CB1831	3
49,60	Fixed, comp., 560 ohm ± 10% ¼W	RC-104-156	A-B	CB5611	2
50,62	Fixed comp., 4.7 ohm ± 10% ¼W	RC-104-R47	A-B	CB47G1	2
51,61	Fixed, comp., 15k ohm ± 10% ¼W	RC-104-315	A-B	CB1531	2
52,53	Deposited carb. 10k ohm, matched set .1%	RX-000-003	W-I	RX-000-003	1
54	Fixed, comp., 1.2M ohm ± 10% ¼W	RC-104-512	A-B	CB1251	1
57	Deposited carb. 21.5k } matched set	RX-000-004	W-I	RX-000-004	1
58	Deposited carb. 19.k } 9:8 within .1%				
" Q "	TRANSISTORS				
1,14	NPN, Silicon, Dual	QB-000-010	SPR	TD101	2
2,3,4,15	PNP, Silicon	QA-042-500	FCD	2N4250	4
5,6,7,11,12 13	P Channel JFET	QA-054-610	MOT	2N5461	6
8,17	PNP, Silicon, Dual	QB-000-011	SPR	TD401	2
9,10,16,18	NPN, Silicon	QA-050-880	MOT	2N5088	4
19	PNP, Silicon	QB-000-009	MOT	MPS3702	1

OSCILLATOR-MIXER SCHEMATIC
MODULE M9G & M9H

REV C



PARTS LIST — MODULE M9G M9H REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,3,7,8,9, 11,14,18,19, 25,27	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	11
2,10	Ceramic disc, 100pF ±10% 1kV	CD-108-110	RMC	C,N750	2
5,12,4	Ceramic feedthru, 100pF ±20% 250V	CF-104-110	AER	EF4	3
6,13	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	2
15,28,29,30	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	4
16	Ceramic disc, 120pF ±20% 1kV	CD-102-112	SPR	5GAT12	1
17,33,34	Electrolytic, .47uF 50V	CE-113-447	TRW	935	3
20	Composition, .75pF ±10% 500V	CG-101-175	Q-C	QC.75	1
21	Factory adjusted, nominal value shown	Not Assign.	---	--------	--
22	Composition, 1.1uF ±10%, factory adj.	CG-101-211	Q-C	QC1.1	1
23,26	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TGS10	2
24	Factory adjusted, nominal value shown	Not Assign.	---	--------	--
31	Electrolytic, 10uF 25V	CE-105-010	SPR	TE1204	1
32	Ceramic disc, .05uF ±20% 100V	CD-103-350	SPR	TGS50	1
35	Ceramic disc, .001uF ± 20% 1kV	CD-102-210	SPR	5GAD10	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm, submin.	JF-000-005	APL	27-9	2
"CR "	DIODES				
1,2,3,4,5	Voltage variable capacitance	DC-000-005	W-I	DC-000-005	5
6	Not assigned	----------	---	---------	--
7,10,11	Zener, 6.8V	DB-000-001	C-L	HW-6.8	3
8,9	Silicon, point contact	DG-100-821	SYL	IN82AS	2
"L "	INDUCTORS				
1,3	Fixed, .22uH	LA-005-R02	W-E	506	2
2,7	Fixed ------	Not Assign.	W-I	----------	--
4	Fixed ------	Not Assign.	W-I	----------	--
5	Fixed ------	Not Assign.	W-I	----------	--
6	Fixed 1uH	LA-005-R10	W-E	506	1
8	Fixed ------	Not Assign.	W-I	----------	--
9,10	Fixed ------	LA-006-004	W-I	LA-006-004	2
"R "	RESISTORS				
1	Fixed, comp., 22kohm ±10% ¼W	RC-104-322	A-B	CB2231	1
2,12	Variable,cermet, 10kohm ±20%	RP-129-310	CTS	360S103B	2
3,14,17,24	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	4
4,19,39,40, 47,48	Fixed, comp., 470ohm ±10% ¼W	RC-104-147	A-B	CB4711	6
5,6,15,20,21, 41,49	Fixed, comp., 4.7kohm ±10% ¼W	RC-104-247	A-B	CB4721	7
7,22,	Fixed, comp., 10ohm ±10% ¼W	RC-104-010	A-B	CB1001	2
8,29	Fixed, comp., 5.6kohm ±10% ¼W	RC-104-256	A-B	CB5621	2
9	Variable, cermet, 20kohm ±10%	RP-129-320	CTS	360S203B	1
10,23,27,35	Not Assigned	----------	---	----------	--
11	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	1
13	Variable, carbon, 20kohm ±20%	RP-124-320	A-B	WA2G032	1
16, 30	Fixed, comp., 33kohm ±10% ¼W	RC-104-333	A-B	CB3331	2

PARTS LIST — MODULE M9G M9H REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
18	Fixed, comp., 2.2kohm ±10% ¼W	RC-104-222	A-B	CB2221	1
25	Fixed, comp., 1.5kohm ±10% ¼W	RC-104-215	A-B	CB1521	1
26	Fixed, comp., 27kohm ±10% ¼W	RC-104-327	A-B	CB2731	1
28	Fixed, comp., 39kohm ±10% ¼W	RC-104-339	A-B	CB3931	1
31	Fixed, comp., 100kohm ±10% ¼W	RC-104-410	A-B	CB1041	1
32	Fixed, comp., 27kohm ± 5% ¼W	RC-103-327	A-B	CB2735	1
33	Fixed, comp., 33kohm ± 5% ¼W	RC-103-333	A-B	CB3335	1
34	Fixed, comp., 12kohm ±10% ¼W	RC-104-312	A-B	CB1231	1
36	Fixed, comp., 4.7ohm ±10% ¼W	RC-104-R47	A-B	CB47G1	1
37	Fixed, comp., 220ohm ±10% ¼W	RC-104-122	A-B	CB2211	1
38,43,45,46, 51	Fixed, comp., 100ohm ±10% ¼W	RC-104-110	A-B	CB1011	5
42,44,50	Fixed, comp., 47ohm ±10% ¼W	RC-104-047	A-B	CB4701	3
52	Fixed, comp., 22ohm ±10% ¼W	RC-104-022	A-B	CB2201	1
53	Fixed, comp., 150ohm ±10% ¼W	RC-104-115	A-B	CB1511	1
"Q "	TRANSISTORS				
1,4,5,9	PNP, Silicon,	QB-000-009	MOT	MPS3702	4
2,6,11,12,13, 14,15,16	NPN, Silicon,	QA-051-790	RCA	2N5179	8
3,7,10	NPN, Silicon,	QA-038-541	G-E	2N3854A	3
8	PNP, Silicon, dual	QB-000-011	SPR	TD401	1

OUTPUT AMPLIFIER SCHEMATIC
MODULE MIOH & MIOH-1
REV E

B+ 1
30.5 mA
11
L1
C1 470
C2 .01μF
R8 100
R11 100
C5 .025μF
C3 500
C4 500
R7 470
Q2 A430
RF INPUT
J1
CR1
CR3
C6 .47μF
R12 27
C8 .47μF
Q1 A430
R1 47
CR2
R5 47
R6 150
L4
L5
R10 470
C7 .47μF
L2
R2 330
L3
R9 47
C34 200
R3 1K
Q7 MPS3702
C35 200
B-1
12
C17 470
R32 100K
CR9
R33 1K
R34 10K
+18
C21 360
C20 .001μF
C18 6.8
BLANKING INPUT
4
R35 1M
2N5458 Q8
R36 2.2M
R53 150K *
R41 1.2K
C22 .005μF
C23 10μF
R48 1.2M
R44 220
+18
C25 120
R46 1K
R45 4.7K
C36 47
Q10 MPS3702
C19 6.8
LEVEL CONTROL INPUT
7
R37 20K
MAX
R38 15K [10K]
-18
R42 680K * [DELETE]
R43 2.7K
Q9 TD101
R47 10K
R49 47K
R50 100
CR10
Q11 MPS3702
R51 4.7K
R52 220
MIN
R40 470K [220K]
R39 20K
C24 6.8
5
MONITOR INPUT
MIOH-1 VALUE DIFFERENCES ARE SHOWN IN BRACKETS [ ]
Q3 SD1006
Q4 A430
R23 360
Q5 SD1006
Q6 SD1006
R26 47
CR4
CR5
R30 470
C15 .47μF
J2
RF OUTPUT
R16 1.5K
L6
R17 10
R19 82
R21 27
C11 4.7
C12 10
L8
L10
R27 33K
R31 33K
CR6
CR7
CR8
R24 150
R28 33K *
-18
R29 100
C16 100
R13 470
R15 82
R18 22
L7
C9 10μF
C10 15
R20 82
C13 10μF
R14 10
R22 10
R25 10
L9
C14 10μF
C33 6.8
6
LEVELER OUTPUT
L11
C27 .01μF
C29 .01μF
C31 .01μF
L12 10mH
C26 470
1
C28 470
2
C30 470
3
C32 6.8
9
-20V
183 mA
+18V
7.3 mA
-18V
7.4 mA
SWEEP DRIVE

PARTS LIST — MODULE M10H M10H-1 REV E

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,17,26,28, 30	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	5
2,27,29,31	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	4
3,4	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	2
5	Ceramic disc, .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
6,7,8,15	Electrolytic, .47uF 50V	CE113-447	TRW	935	4
9,13,14,23	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	4
10	Ceramic disc, 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
11	Ceramic disc, 4.7pF ±5% 1kV	CD101-R47	SPR	10TCC-V47	1
12	Ceramic disc, 10pF ±5% 1kV	CD101-010	SPR	10TCC-Q10	1
16	Ceramic feedthru, 100pF ±20% 250V	CF104-110	AER	EF4	1
18,19,24,32, 33	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
20	Ceramic disc, .001uF ±20% 1kV	CD102-210	APR	5GA-D10	1
21	Ceramic disc, 360pF ±20% 1kV	CD102-136	SPR	5GA-T36	1
22	Ceramic disc, .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
25	Ceramic disc, 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
34,35	Ceramic disc, 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	2
36	Ceramic disc, 47pF ±5% 1kV	CD104-047	SPR	10TCU-Q47	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin.	JF000-005	APL	27-9	2
"CR "	DIODES				
1,2,3	Silicon, P.I.N.	DP000-050	W-I	DP000-050	3
4,5,6,7	Voltage variable capacitance	DC000-008	W-I	DC000-008	4
8	Silicon, Hot Carrier	DG000-007	W-I	DG000-007	1
9,10	Silicon, Junction, 100piV, 750mA	DR000-001	ITT	1N4002	2
"L "	INDUCTORS				
1,4,5,9,11	Fixed,----	LA006-010	W-I	LA006-010	5
2,3	Fixed, ----	Not Assign.	W-I	----------	--
6,7,8,10	Fixed, ----	LA006-004	W-I	LA006-004	4
12	Fixed, 10mH	LA004-310	JEF	15S103K	1
"R "	RESISTORS				
1,5,9,26	Fixed, comp., 47ohm ±10% ¼W	RC104-047	A-B	CB4701	4
2	Fixed, comp., 330ohm ±10% ¼W	RC104-133	A-B	CB3311	1
3,33,46	Fixed, comp., 1kohm ±10% ¼W	RC104-210	A-B	CB1021	3
4	Not Assigned	---------	---	----------	--
6	Fixed, comp., 150ohm ±10% ¼W	RC104-115	A-B	CB1511	1
7,10,30	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	3
8,11,50	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
12,21	Fixed, comp., 27ohm ±10% ¼W	RC104-027	A-B	CB2701	2
13	Fixed, comp., 470ohm ±5% ¼W	RC103-147	A-B	CB4715	1
14,17,22,25	Fixed, comp., 10ohm ±5% ¼W	RC103-010	A-B	CB1005	4
15,19,20	Fixed, comp., 82ohm ±5% ¼W	RC103-082	A-B	CB8205	3
16	Fixed, comp., 1.5kohm ±5% ¼W	RC103-215	A-B	CB1525	1
18	Fixed, comp., 22ohm ±10% ¼W	RC104-022	A-B	CB2201	1
23	Fixed, comp., 360ohm ±5% ½W	RC105-136	A-B	EB3615	1

PARTS LIST — MODULE M10H & M10H-1 REV E

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
24	Fixed, comp., 150ohm +5% 1W	RC107-115	A-B	GB1515	1
27,28,31	Fixed, comp., 33kohm ±10% ¼W	RC104-333	A-B	CB3331	3
29	Fixed, comp., 100ohm ±5% 1W	RC107-110	A-B	GB1015	1
32	Fixed, comp., 100kohm ±10% ¼W	RC104-410	A-B	CB1041	1
34,(38),47	Fixed, comp., 10kohm ±10% ¼W	RC104-310	A-B	CB1031	3
35	Fixed, comp., 1Mohm ±10% ¼W	RC104-510	A-B	CB1051	1
36	Fixed, comp., 3.3Mohm ±10% ¼W	RC104-522	A-B	CB2251	1
37,39	Variable, carbon 20kohm +20% ¼W	RC104-320	A-B	WA2G032	2
38	Fixed, comp., 15kohm ±10% ¼W	RC104-315	A-B	CB1531	1
40	Fixed, comp., 470kohm ±10% ¼W	RC104-447	A-B	CB4741	1
(40)	Fixed, comp., 220kohm ±10% ¼W	RC104-422	A-B	CB2241	1
41	Fixed, comp., 1.2kohm ±10% ¼W	RC104-212	A-B	CB1221	1
42	Fixed, comp., 680kohm ±10% ¼W	RC104-468	A-B	CB6841	1
43	Fixed, comp., 2.7kohm ±10% ¼W	RC104-227	A-B	CB2721	1
44,52	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	2
45,51	Fixed, comp., 4.7kohm ±10% ¼W	RC104-247	A-B	CB4721	2
(48)	Fixed, comp., 1.2Mohm ±10% ¼W	RC104-512	A-B	CB1251	1
49	Fixed, comp., 47kohm ±10% ¼W	RC104-347	A-B	CB4731	1
53	Fixed, comp., 150kohm ±10% ¼W	RC104-415	A-B	CB1541	1
"Q "	TRANSISTORS				
1,2,4	NPN, Silicon	QB000-013	AER	A430	3
3,5,6	NPN, Silicon	QB000-018	SSS	SD1006	3
7,10,11	PNP. Silicon	QB000-009	MOT	MPS3702	3
8	N-channel JFET, Silicon	QA054-580	MOT	2N5458	1
9	NPN, Silicon, dual	QB000-010	SPR	TD101	1

SWEEP OSCILLATOR SCHEMATIC
BAND 2 & 3
MODULE M19H

REV D

NOTE A
HARMONIC SUPPRESSION CAPACITORS MAY OR MAY NOT BE PRESENT AT THESE POINTS

SWEEP DRIVE 9
LEVEL PROGRAM 7
LEVELER INPUT 6
MONITOR OUTPUT 8
"C" BAND 1 INPUT J1
"D" SWEEP SAMPLE OUTPUT BANDS 2 & 3 J2
RF OUTPUT BANDS 1, 2 & 3 J3
TO SWEEP SAMPLE J2
TO SWEEP SAMPLE J2
NOTE A
NOTE A
CENT. BAND 2
CENT. BAND 3
B-2 BAND 2 CW 40 mA
B-3 BAND 3 CW 70 mA
-16 7mA
+18 BAND 2 (CW) 37mA BAND 3 (CW) 65 mA
-18 2mA

PARTS LIST — MODULE M19H REV D

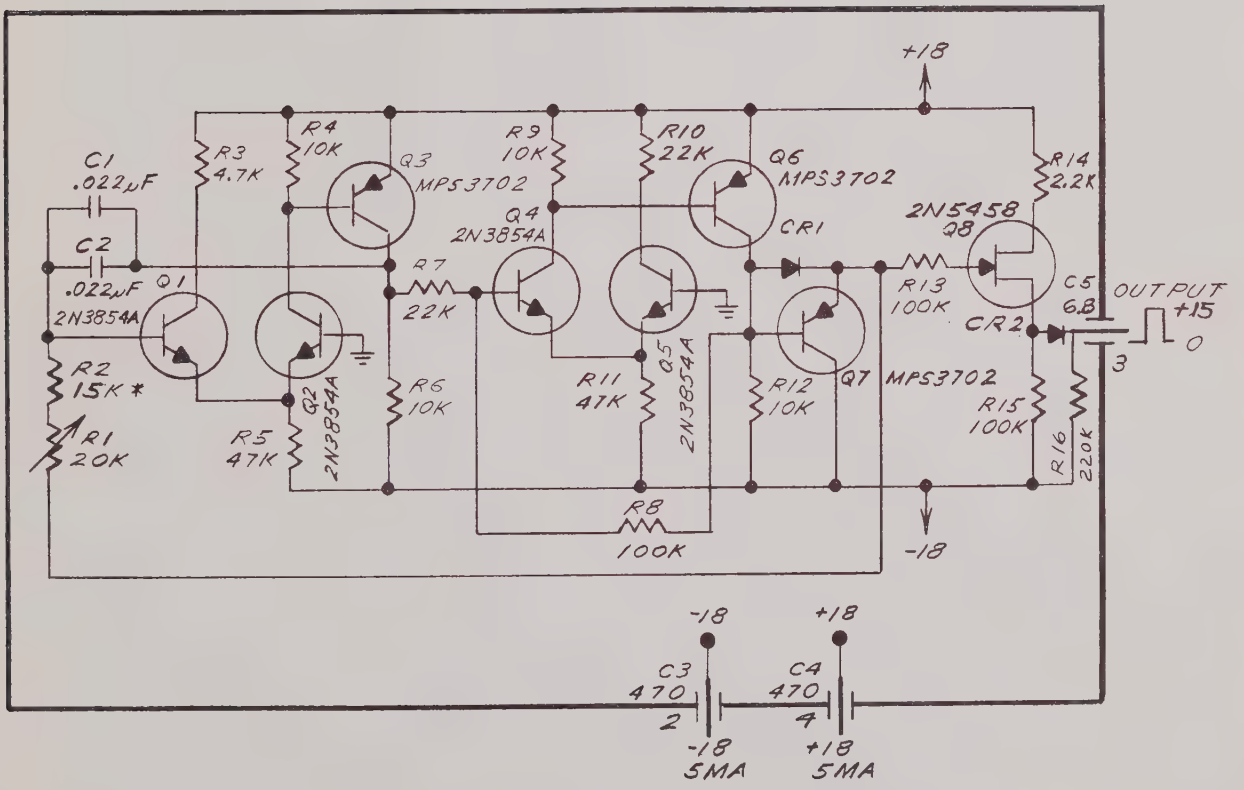
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,13,24,25	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
26					
2,4,5,6,10	Ceramic feedthru 500pF ±20% 250V	CF104-150	AER	EF4	14
11,12,14,					
15,16,17,18					
22,23					
3,8,9,19,20,	Ceramic feedthru 100pF ±20% 250V	CF104-110	AER	EF4	6
21					
7	Composition .75pF ±10% 500V	CG101-175	Q-C	QC.75	1
27,28,29,30	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	5
31,32					
Note A	Composition, from .2pF to 1pF	CG102----	Q-C	QC	--
"J "	CONNECTORS				
1,2,3	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	3
"CR "	DIODES				
1,10,11,21	Silicon, Junction 100piV, 750mA	DR000-001	ITT	1N4002	4
2,3,4,5,13	Voltage variable capacitance	DC000-008	W-I	DC000-008	8
14,15,16					
6,7,8,9,12	Silicon, P.I.N.	DP000-040	W-I	DP000-040	8
17,18,19					
20	Silicon, point contact	DG100-821	SYL	1N82AS	1
"L "	INDUCTORS				
1,2,10,11,12	Fixed, -----	LA006-004	W-I	LA006-004	8
13,21,22					
3,5,14,16	Fixed, .22uH	LA005-R02	W-E	506	4
4,7,8,15	Fixed, -----	Not assign.	W-I	Not assign.	--
17,18,19					
6	Fixed, -----	Not assign.	W-I	Not assign.	--
9,20	Fixed, -----	Not assign.	W-I	Not assign.	--
23	Fixed, -----	Not assign.	W-I	Not assign.	--
24	Fixed, -----	LA006-010	W-I	LA006-010	1
25,26	Fixed, -----	LA007-004	W-I	LA007-004	2
"R "	RESISTORS				
1,30	Fixed, comp. 7.5kohm ±5% ¼W	RC103-275	A-B	CB7525	2
2,7,32,39	Fixed, comp. 4.7kohm ±10% ¼W	RC104-247	A-B	CB4721	5
40					
3	Fixed, comp. 10Mohm ±10% ¼W	RC104-610	A-B	CB1061	1
4,45,48	Fixed, comp. 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
5,19,24,28	Fixed, comp. 22kohm ±10% ¼W	RC104-322	A-B	CB2231	5
33					
6,23,27,34	Fixed, comp. 68kohm ±10% ¼W	RC104-368	A-B	CB6831	4
8,17,18,35	Fixed, comp. 100kohm ±10% ¼W	RC104-410	A-B	CB1041	6
49,50					
9,10	Fixed, comp. 220ohm ±10% ½W	RC106-122	A-B	EB2211	2
11,32	Fixed, comp. 390ohm ±10% ¼W	RC104-139	A-B	CB3911	2
12,13,36	Fixed, comp. 2.2kohm ±10% ¼W	RC104-222	A-B	CB2221	3
14,16	Variable, wire wound 10kohm	RV102-310	BOU	3067P	2
15	Fixed, comp. 3.9kohm ±10% ¼W	RC104-239	A-B	CB3921	1
20	Fixed, comp. 39kohm ±10% ¼W	RC104-339	A-B	CB3931	1

PARTS LIST — MODULE M19H REV D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
21	Fixed, comp. 91kohm ±5% ¼W	RC103-391	A-B	CB9135	1
22,26	Fixed, adjustable, nominal value shown	RC104----	---	--------	---
25,29	Fixed, comp. 47kohm ±10% 1W	RC104-347	A-B	GB4731	2
37	Fixed, comp. 160ohm ±5% 1W	RC107-116	A-B	GB1615	1
38	Fixed, comp. 82ohm ±10% ½W	RC106-082	A-B	EB8201	1
41	Fixed, comp. 470ohm ±10% 1W	RC108-147	A-B	GB4711	1
42	Fixed, comp. 47ohm ±10% ¼W	RC104-047	A-B	CB4701	1
43	Fixed, comp. 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
44	Fixed, comp. 1kohm ±10% ¼W	RC104-210	A-B	CB1021	1
46	Fixed, comp. 47ohm ±5% ½W	RC105-047	A-B	EB4705	1
47	Fixed, comp. 56ohm ±10% ¼W	RC104-056	A-B	CB5601	1
"Q "	TRANSISTORS				
1,4,7,8,9,	NPN, Silicon	QB000-009	MOT	MPS3702	8
11,15,16					
2,5,10,12,13	NPN, Silicon	QA038-541	G-E	2N3854A	5
3	P-channel JFET	QA054-610	MOT	2N5461	1
6	NPN, Silicon	QA051-090	SSS	2N5109	1
14	NPN, Silicon	QB000-015	W-I	QB000-015	1

1kHz MODULATOR SCHEMATIC
(OPTION A4) MODULE M6Z

REV C



PARTS LIST

MODULE M6Z REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2	Mylar paper, .022uF ±10% 200V	CP-101-322	C-D	WMF	2
3,4	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	2
5	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	1
"CR "	DIODES				
1,2	Silicon, junction, 100piV 750mA	DR-000-001	ITT	IN4002	2
"R "	RESISTORS				
1	Variable, carbon, 20kohm ±20% ¼W	RP-124-320	A-B	WA2032	1
2	Fixed, comp., 15kohm ±10% ¼W	RC-104-315	A-B	CB1531	1
3	Fixed, comp., 4.7kohm ±10% ¼W	RC-104-247	A-B	CB4721	1
4,6,9,12	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	4
5,11	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	2
7,10	Fixed, comp., 22kohm ±10% ¼W	RC-104-322	A-B	CB2231	2
8,13,15	Fixed, comp., 100kohm ±10% ¼W	RC-104-410	A-B	CB1041	3
14	Fixed, comp., 2.2kohm ±10% ¼W	RC-104-222	A-B	CB2221	1
16	Fixed, comp., 220kohm ±10% ¼W	RC-104-422	A-B	CB2241	1
"Q "	TRANSISTORS				
1,2,4,5	NPN, Silicon	QA-038-541	G-E	2N3854A	4
3,6,7	PNP, Silicon	QB-000-009	MOT	MPS3702	3
8	N-channel, J-FET	QA-054-580	MOT	2N5458	1

MARKER ADDER SCHEMATIC
MODULE M5G AND M5H

REV. C

SWEEP SAMPLE INPUTS

SWEEP SAMPLE OUTPUT

BAND 1 "A" J2

BAND 2+3 "D" J3

J4

SWEEP SAMPLE

EXTERNAL MARKER INPUT .1V J1

BIRDY INPUTS 12MV PTOP

R1 1K
R2 180
R3 680
R4 56
R5 56
CR2 IN82
C1 500
C2 .025μF
Q1 2N5088
R6 22K
R7 270
R8 22K
-18
R56 47K
+18

C3 6.8 (1)
C4 6.8 (2)
C5 6.8 (3)
C6 6.8 (4)

Q2 2N5088
R9 5.6K
R11 270
R10 22K
-18

Q3 2N5088
R12 5.6K
R14 270
R13 22K
-18

Q4 2N5088
R15 5.6K
R17 270
R16 22K
-18

Q5 2N5088
R18 5.6K
R20 270
C7 10μF
R19 22K
-18

R31 2.7K
CR4
CR5
R38 4.7K
B-1

C19 .054μF
R39 2.7K
C20 .005μF
R40 2.2K
R41 100
L2
C21 500

CR6
R42 47
CR7 IN82
R43 47
C22 500
L1 .22μH

NOTE: M5H AS SHOWN - M5G OMIT PARTS IN SHADED AREA AND CONNECT C-19 DIRECTLY TO J-2

R48 1K
C23 470
2N5458 Q11
R44 1M
R45 2.2M
-18
S.S. LEVEL 20K R46
+18
R47 470K
R49 2.7K

R53 220 +18
R50 4.7K
R51 10K
MPS3702 Q13
C24 1.20
Q12 TD101
R54 47K
R55 47K
R52 10K
-18

+18

R23 10K
R24 4.7K
Q7 MPS3702
CR3
R31 10K
R35 680
Q9 MPS3702
C14 .05μF
R32 1K
MARKER OUTPUT 32V PTOP
C18 6.8 (7)
10K SIZE

+18
R21 3.3K
5
C8 .05μF
R22 10K
Q6 TD101
R27 220K
R30 1.8K
C15 .05μF
R33 1K
Q10 2N3854A
R25 47K
R26 2.2K
R28 10K
Q8 MPS3702
R29 3.3K
R34 10K
R36 680

B-1
-18
C16 100μF
+18 C17 100μF

C9 6.8 (12)
C10 6.8 (11)
C11 6.8 (8)
TO SHAPER

C12 470 (9) B-1
C13 6.8 (10)
C24 470
C26 470
-18 15MA (5)
+18 12MA (6)

PARTS LIST — MODULE M5H REV. C

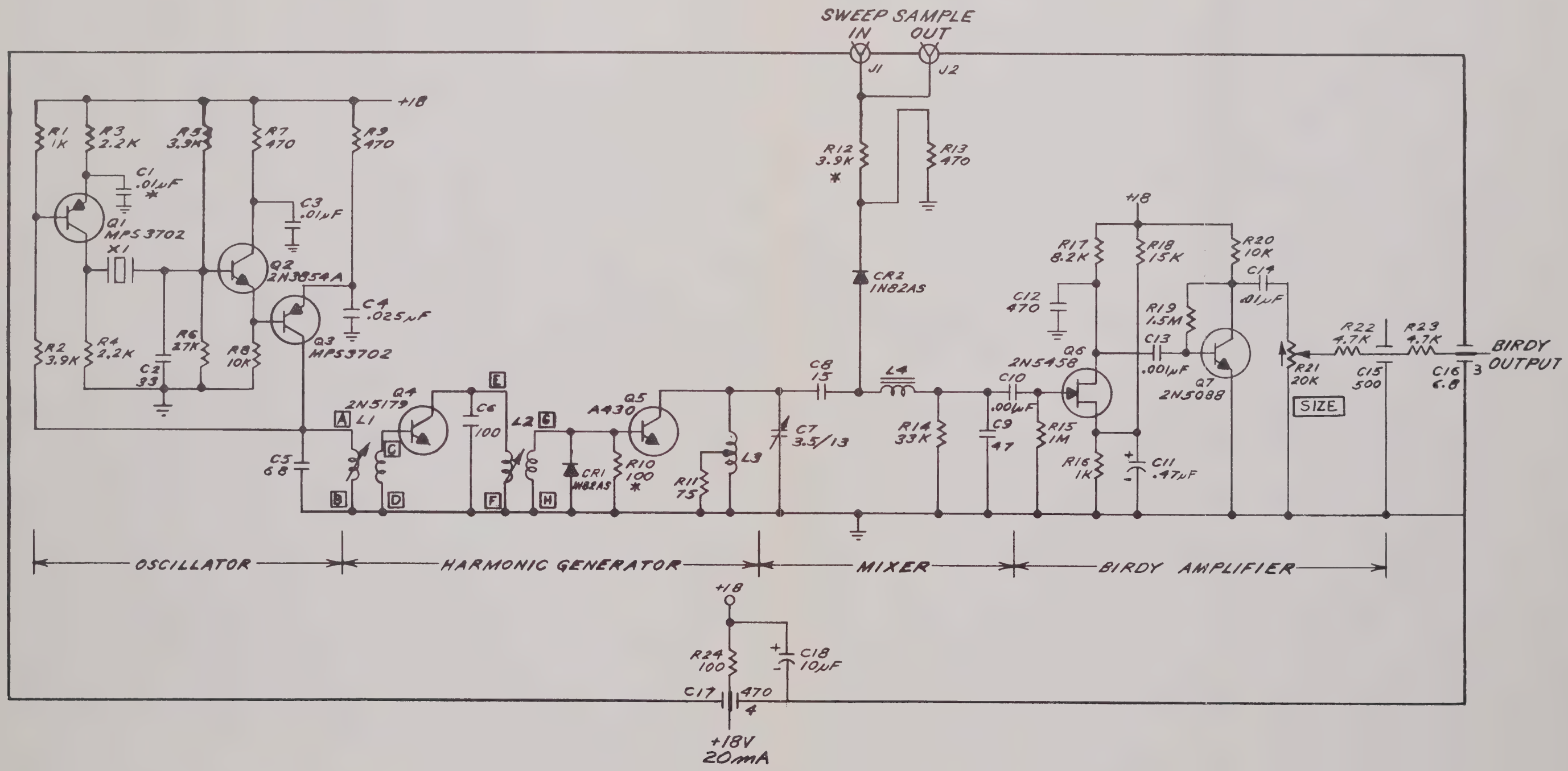
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,21,22	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	3
2	Ceramic disc., .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
3,4,5,6,9	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	9
10,11,13,18					
7	Electrolytic 10uF 25V	CE105-010	SPR	TE-1204	1
8,14,15,19	Ceramic disc., .05uF ±20% 100V	CD103-350	SPR	TG-S50	4
12,24,26	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	3
16,17	Electrolytic 100uF 25V	CE105-110	SPR	TE-1211	2
20	Ceramic disc., .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
23	Ceramic disc., 470uF ±20% 1kV	CD102-147	SPR	5GAT47	1
24	Ceramic disc., 120uF ±20% 1kV	CD102-112	SPR	5GAT12	1
"J "	CONNECTORS				
1,2,3,4	Jack, receptacle, 50ohm, submin.	JF000-005	APL	27-9	4
"CR "	DIODES				
2,7	Silicon, point contact	DG100-821	SYL	1N82AS	2
3	Silicon, junction, 100piV 750mA	DR000-001	ITT	1N4002	1
4,5,6	Silicon, P.I.N.	DP000-040	W-I	DP000-040	3
"L "	INDUCTORS				
1	Fixed, .22uH	LA005-R02	W-E	506	1
2	Fixed	LA006-010	W-I	LA006-010	1
"R "	RESISTORS				
1,32,33,48	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	4
2	Fixed, comp., 180ohm ±10% ¼W	RC104-118	A-B	CB1811	1
3,35,36	Fixed, comp., 680ohm ±10% ¼W	RC104-168	A-B	CB6811	3
4,5	Fixed, comp., 56ohm ±10% ¼W	RC104-056	A-B	CB5601	2
6,8,10	Fixed, comp., 22k ±10% ¼W	RC104-322	A-B	CB2231	6
13,16,19					
7,11,14	Fixed, comp., 270ohm ±10% ¼W	RC104-127	A-B	CB2711	5
17,20					
9,12,15	Fixed, comp., 5.6k ±10% ¼W	RC104-256	A-B	CB5621	4
18					
21,29	Fixed, comp., 3.3k ±10% ¼W	RC104-233	A-B	CB3321	2
22,23,28	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	7
31,34,51					
52					
24,38,50	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	3
25,54,55,56	Fixed, comp., 47k ±10% ¼W	RC104-347	A-B	CB4731	4
26,40	Fixed, comp., 2.2k ±10% ¼W	RC104-222	A-B	CB2221	2
27	Fixed, comp., 220k ±10% ¼W	RC104-422	A-B	CB2241	1
30	Fixed, comp., 1.8k ±10% ¼W	RC104-218	A-B	CB1821	1
37,39,49	Fixed, comp., 2.7k ±10% ¼W	RC104-227	A-B	CB2721	3
41	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	1
42	Fixed, comp., 47ohm ±5% ½W	RC105-047	A-B	EB4705	1
43	Fixed, comp., 47ohm ±5% ¼W	RC103-047	A-B	CB4705	1
44	Fixed, comp., 1M ±10% ¼W	RC104-510	A-B	CB1051	1
45	Fixed, comp., 2.2M ±10% ¼W	RC104-522	A-B	CB2251	1

PARTS LIST — MODULE M5H REV. C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS (Continued)				
46	Variable, carbon 20k ±20% ¼W	RP124-320	A-B	WA2G032	1
47	Fixed, comp., 470k ±10% ¼W	RC104-447	A-B	CB4741	1
53	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	1
"Q "	TRANSISTORS				
1,2,3,4	NPN, Silicon	QA050-880	MOT	2N5088	5
5					
6,12	Dual NPN, Silicon	QB000-010	SPR	TD101	2
7,8,9,13	PNP, Silicon	QB000-009	MOT	MPS3702	4
10	NPN, Silicon	QA038-541	GE	2N3854A	1
11	N-channel JFET	QA054-580	MOT	2N5458	1

HARMONIC MARKER SCHEMATIC
(OPTION A2) INTERVAL: 1 MHz
MODULE M6H1

REV E



PARTS LIST — MODULE M6H 1 REV E

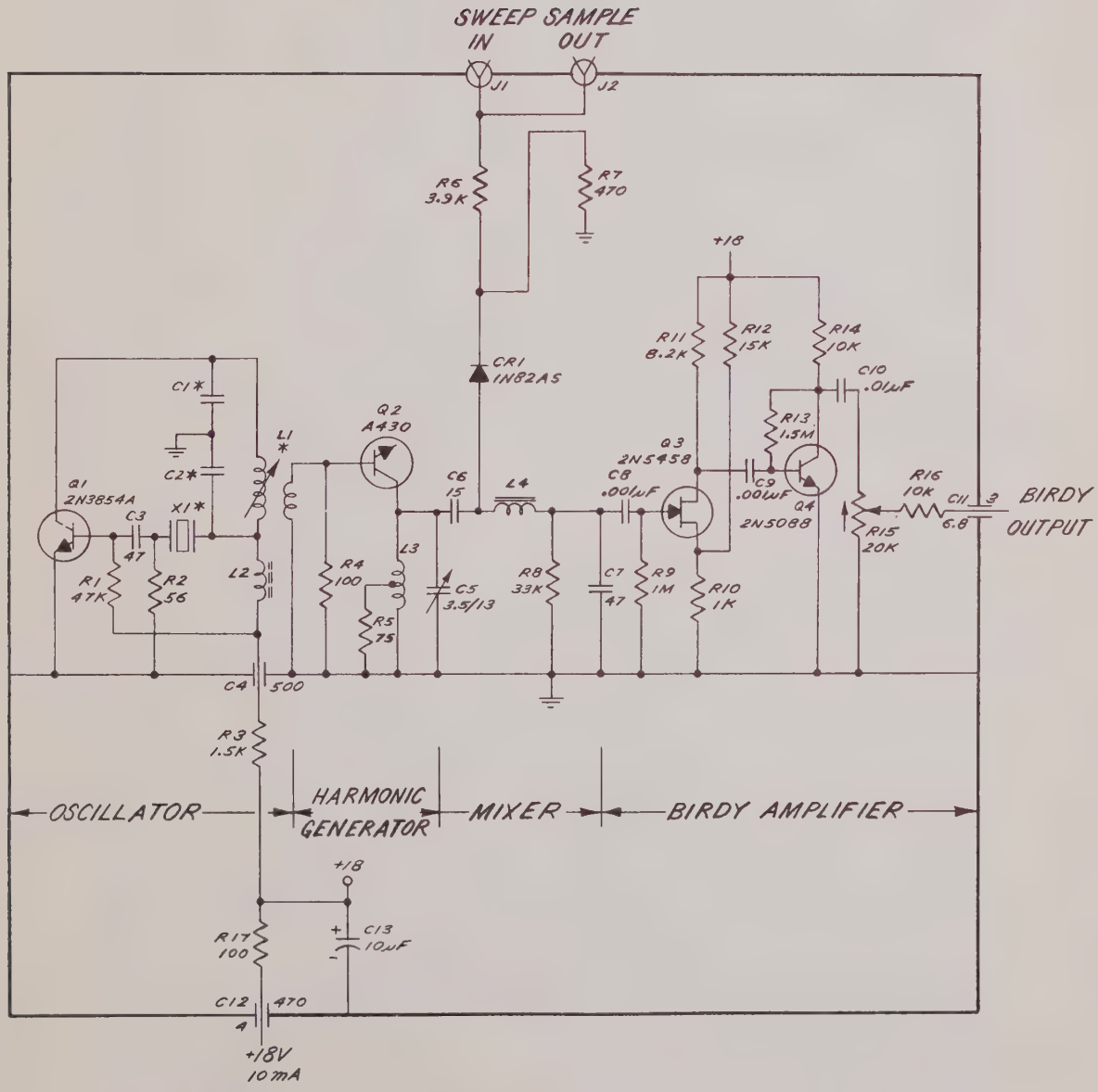
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C"	CAPACITORS				
1,3,14	Ceramic disc, .01uF +20% 100V	CD-103-310	SPR	TG-S10	2
2	Ceramic disc, 33pF +5% 1kV	CD-104-033	SPR	10TCU-Q33	1
4	Ceramic disc, .025uF +20% 100V	CD-103-325	SPR	TG-S25	1
5	Ceramic disc, 68pF +5% 1kV	CD-104-068	SPR	10TCU-Q68	1
6	Ceramic disc, 100pF +5% 1kV	CD-104-110	SPR	10TCU-T10	1
7	Variable, ceramic, 3.5/13pF	CV-101-013	STR	7S-TRIKO-02	1
8	Ceramic disc, 15pF +5% 1kV	CD-101-015	SPR	10TCC-Q15	1
9	Ceramic disc, 47pF +5% 1kV	CD-104-047	SPR	10TCU-Q47	1
10,13	Ceramic disc, .001uF +20% 1kV	CD-102-210	SPR	5GA-D10	2
11	Electrolytic, .47uF +10% 50V	CE-113-447	TRW	935	1
12	Ceramic disc, 470pF +20% 1kV	CD-102-147	SPR	5GA-T47	1
15	Ceramic feedthru, 500pF +20% 250V	CF-104-150	AER	EF4	1
16	Ceramic feedthru, 6.8pF +10% 500V	CF-102-R68	A-B	FASC	1
17	Ceramic feedthru, 470pF +10% 500V	CF-101-147	A-B	FASC	1
18	Electrolytic, 10uF 25V	CE-105-010	SPR	TE1204	1
"J"	CONNECTORS				
1,2	Jack, receptacle, 50ohm, submin.	JF-000-005	APL	TE1204	2
"X"	CRYSTALS				
1	X25W at 1MHz	XX-000-251	W-I	XX-000-251	1
"CR"	DIODES				
1,2	Silicon, point contact	DG-100-821	SYL	IN82AS	2
"L"	INDUCTORS				
1	Coil form LB-002-000 with 160 turns, 20 turns 32 ga. wire	Not Assign.	---	----------	1
2	Coil form LB-003-000 with 35 turns, 10 turns 32 ga. wire	Not Assign.	---	----------	1
3	-------24 ga. wire	Not Assign.	---	----------	-
4	Fixed -----	LA-006-004	W-I	LA-006-004	1
"R"	RESISTORS				
1,16	Fixed comp., 1k ohm +10% ¼W	RC-104-210	A-B	CB1021	2
2,5,12	Fixed comp., 3.9 ohm +10% ¼W	RC-104-239	A-B	CB3921	3
3,4	Fixed comp., 2.2k ohm +10% ¼W	RC-104-222	A-B	CB2221	2
6	Fixed comp., 27k ohm +10% ¼W	RC-104-327	A-B	CB2731	1
7,9,13	Fixed comp., 470 ohm	RC-104-147	A-B	CB4711	3
8,20	Fixed comp., 10k ohm +10% ¼W	RC-104-310	A-B	CB1031	2
10,24	Fixed comp., 100 ohm +10% ¼W	RC-104-110	A-B	CB1011	2
11	Fixed comp., 75 ohm +5% ¼W	RC-103-075	A-B	CB7515	1
14	Fixed comp., 33k ohm +10% ¼W	RC-104-333	A-B	CB3331	1
15	Fixed comp., 1M ohm +10% ¼W	RC-104-510	A-B	CB1051	1
17	Fixed comp., 8.2k ohm +10% ¼W	RC-104-282	A-B	CB8221	1
18	Fixed comp., 15k ohm +10% ¼W	RC-104-315	A-B	CB1531	1
19	Fixed comp., 1.5M ohm +10% ¼W	RC-104-515	A-B	CB1551	1
21	Variable, carbon 20k ohm +20% ½W	RP-124-320	A-B	WA2032	1
22,23	Fixed comp., 4.7k ohm +10% ¼W	RC-104-247	A-B	CB4721	2

PARTS LIST — MODULE M6H 1 REV E

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,3	PNP, Silicon	QB-000-009	MOT	MPS3702	2
2	NPN, Silicon	QA-038-541	G-E	2N3854A	1
4	NPN, Silicon	QA-051-790	RCA	2N5179	1
5	NPN, Silicon	QB-000-013	APX	A430	1
6	N-channel JFET	QA-054-580	MOT	2N5458	1
7	NPN, Silicon	QA-050-880	MOT	2N5088	1

HARMONIC MARKER SCHEMATIC
(OPTION A2) INTERVAL: 5 TO 50 MHz
MODULE M6H 5-50

REV A

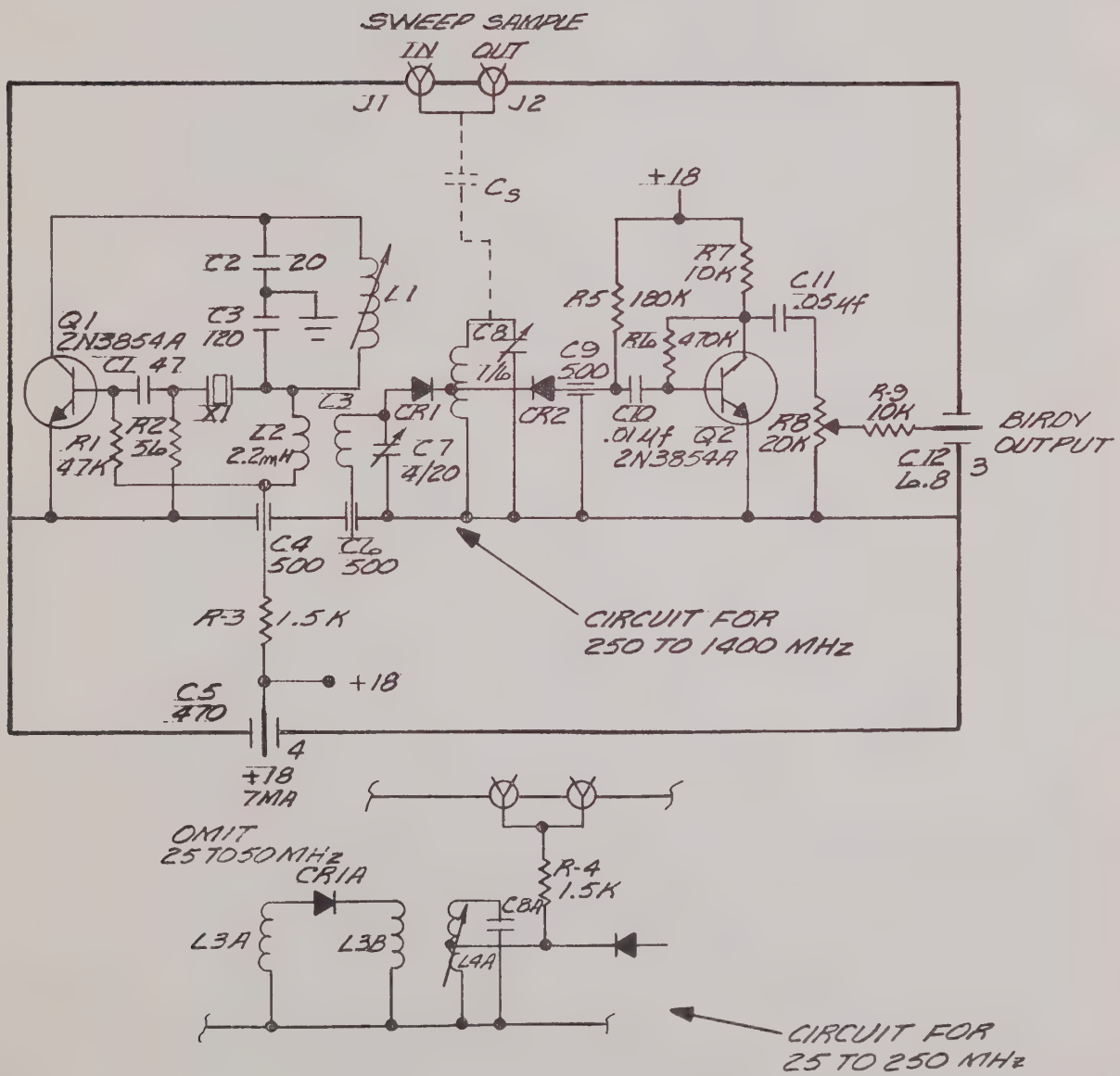


PARTS LIST — MODULE M6H5-50 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2	Ceramic disc, vary with crystal freq.	----------	---	----------	--
3,7	Ceramic disc, 47pF ±5% 1kV	CD104-047	SPR	10TCC-Q47	2
4	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	1
5	Variable, ceramic, 3.5/13pF	CV101-013	STR	7STRIK0-02	1
6	Ceramic disc, 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
8,9	Ceramic disc, .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	2
10	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	1
11	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	1
12	Ceramic feedthru, 470pF ±20% 500V	CF101-141	A-B	FA5C	1
13	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	2
"X "	CRYSTALS				
1	Type to vary with Harmonic interval	----------	---	----------	--
"CR "	DIODES				
1	Silicon, point contact	DG100-821	SYL	IN82AS	1
"L "	INDUCTORS				
1	Coilform with 32 ga. magnet wire, number of turns varies with crystal freq.	Not Assign.	---	----------	--
2	Fixed---	LA006-010	W-I	LA006-010	1
3	Formed from 24 ga. buss wire	Not Assign.	---	----------	--
4	Fixed---	LA006-004	W-I	LA006-004	1
"R "	RESISTORS				
1	Fixed, comp., 47kohm ±10% ¼W	RC104-347	A-B	CB4731	1
2	Fixed, comp., 56ohm ±10% ¼W	RC104-056	A-B	CB5601	1
3	Fixed, comp., 1.5kohm ±10% ¼W	RC104-215	A-B	CB1521	1
4,17	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1021	2
5	Fixed, comp., 75ohm ±5% ¼W	RC103-075	A-B	CB7505	1
6	Fixed, comp., 3.9kohm ±10% ¼W	RC104-239	A-B	CB3921	1
7	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
8	Fixed, comp., 33kohm ±10% ¼W	RC104-333	A-B	CB3331	1
9	Fixed, comp., 1Mohm ±10% ¼W	RC104-510	A-B	CB1051	1
10	Fixed, comp., 1kohm ±10% ¼W	RC104-210	A-B	CB1021	1
11	Fixed, comp., 8.2kohm ±10% ¼W	RC104-282	A-B	CB8221	1
12	Fixed, comp., 15kohm ±10% ¼W	RC104-315	A-B	CB1531	1
13	Fixed, comp., 1.5Mohm ±10% ¼W	RC104-515	A-B	CB1551	1
14,16	Fixed, comp., 10kohm ±10% ¼W	RC104-310	A-B	CB1031	2
15	Variable, carbon, 20kohm ±20% ¼W	RP124-320	A-B	WA2G032	1
"Q "	TRANSISTORS				
1	NPN, Silicon	QA038-541	G-E	2N3854A	1
2	NPN, Silicon	QB000-013	APX	A430	1
3	N-channel JFET	QA054-580	MOT	2N5458	1
4	NPN, Silicon	QA050-880	MOT	2N5088	1

SINGLE FREQ MARKER SCHEMATIC
OPTION A1
FREQ RANGE 25 TO 1400 MHz
MODULE M6S-____

REV A



PARTS LIST

MODULE M6S REV A

25-1400

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
" C "	CAPACITORS				
1	Ceramic disc, 47pF ±5% 1kV	CD-104-047	SPR	10TCU-Q47	
2	Ceramic disc, 20pF ±5% 1kV	CD-101-020	SPR	10TCC-Q20	
3	Ceramic disc, 120pF ±5% 1kV	CD-104-112	SPR	10TCU-T12	
4,6,9	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	
5	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	
7	Variable, ceramic, 4/20pF	CV-105-020	STR	S-TRIKO	
8	Variable, ceramic, 1/6pF	CV-106-R60	APX	2222-802	
8A	Ceramic disc, from 4.7 to 20pF varies with marker freq.	CD-101 ---	SPR	10TCL	
10	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TG-S10	
11	Ceramic disc, .05uF ±20% 100V	CD-103-350	SPR	TG-S50	
12	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	
" J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin.	JF-000-005	APL	27-9	
" X "	CRYSTALS				
1	Quartz crystal, frequency varies with marker frequency	XX-000-331	W-I	XX-000-331	
" CR "	DIODES				
1,2	Silicon, point contact	DG-100-821	SYL	IN82AS	
1A	Silicon, Hot carrier	DG-000-007	H-P	5082-2800	
" L "	INDUCTORS				
1	Coil form No. LB-003-000 wound with 32 gauge magnet wire. Number of turns varies with crystal frequency	Not Assign.	W-I	Not Assign.	
2	Fixed, 2.2uH	LA001-R22	JEF	15	
4A	Coil Form LB-006-000, with magnet wire, gauge and number of turns to vary with marker frequency	Not Assign.	W-I	Not Assign.	
" R "	RESISTORS				
1	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	
2	Fixed, comp., 56ohm ±10% ¼W	RC-104-056	A-B	CB5601	
3,4	Fixed, comp., 1.5kohm ±10% ¼W	RC-104-215	A-B	CB1521	
5	Fixed, comp., 180kohm ±10% ¼W	RC-104-418	A-B	CB1841	
6	Fixed, comp., 470kohm ±10% ¼W	RC-104-447	A-B	CB4741	
7,9	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	
8	Variable, carbon, 20kohm	RP-124-320	A-B	WA2G032	
" Q "	TRANSISTORS				
1,2	NPN, Silicon	QA-038-541	G-E	2N3854A	

SWEEP DRIVE SCHEMATIC
MODULE M2J
REV C

TUNING AND SWEEP PROGRAMS

C1 6.8 (6) · C2 6.8 (7) · C3 6.8 (8)

R1 178K ‡ C22 3.9 · R2 178K ‡ C23 3.9 · R3 2.2M ‡

Q1 TD101 · Q2 2N4250 · Q3 2N4250

R6 4.7K · R7 8.2K * · R8 47K · R9 100 · R10 10K · R11 100 · C4 15 · CR1

+18 · -16 · -18

C5 2.4

R4 20K · R5 470K · +16 · -16

R12 82K · R13 20K · R14 10K · R23 2.2K

CR2 * · CR3 * · CR4 * · CR5 * · CR6 * · CR7 * · CR8 * · CR9 * · CR10 * · CR11 * · CR12 *

R15 470 · R20 2.2K · R21 2.2K · R22 2.2K

R16 20K · R17 4.7K · R18 4.7K · R19 4.7K · Q4 2N4250

+16 · Q14 TD101 · R48 8.2K · -18

R24 100K

Q5 2N5461 · Q6 2N5461 · Q7 2N5461

R25 10M · R26 10M · R27 10M

B-1 · B-2 · B-3

Q8 TD401 · R30 47K · R29 4.7K · R28 10 · R31 27K

+16 · +18 · R32 10K · R33 10 · Q10 2N5088 · R34 47 · C6 25 · CR13 · Q9 2N5088

C17 6.8 (9) · SWEEP DRIVE OUTPUT

C7 10 · -18

R36 18K · R37 18K · R38 18K

Q13 2N5461 · R40 10M · Q12 2N5461 · R39 10M · Q11 2N5461 · R35 10M

R45 4.7K · R46 20K · SWEEP WIDTH3

R43 4.7K · R44 20K · SWEEP WIDTH2

R41 4.7K · R42 20K · SWEEP WIDTH1

+16 · C18 470 (1) · +16 VOLT SUPPLY

+18 · R56 8.2K · R57 21.5K · R58 19.1K · C14 10µF · Q17 TD401

-16 · C19 470 (12) · -16 VOLT SUPPLY

R61 15K · C16 .01µF · C15 470 · Q19 MPS3702 · Q18 2N5088 · R60 560 · R59 470 · CR16 · CR17 · R62 4.7 · -18

R47 470 · CR14 · CR15 · R50 4.7 · R49 560 · Q15 2N4250 · C12 470 · R51 15K · C13 .01µF · Q16 2N5088 · C11 10µF · R52 10K · R53 10K · R54 1.2M · R55 20K · -16 · +16

B-3 · B-1 · B-2

C8 470 (10) · C9 470 (4) · C10 470 (5)

B-3 · B-1 · B-2

C20 470 (3) · -18V 27MA · C21 470 (2) · +18V 27MA

+7 -5

‡ MATCHED

PARTS LIST — MODULE M2J REV C

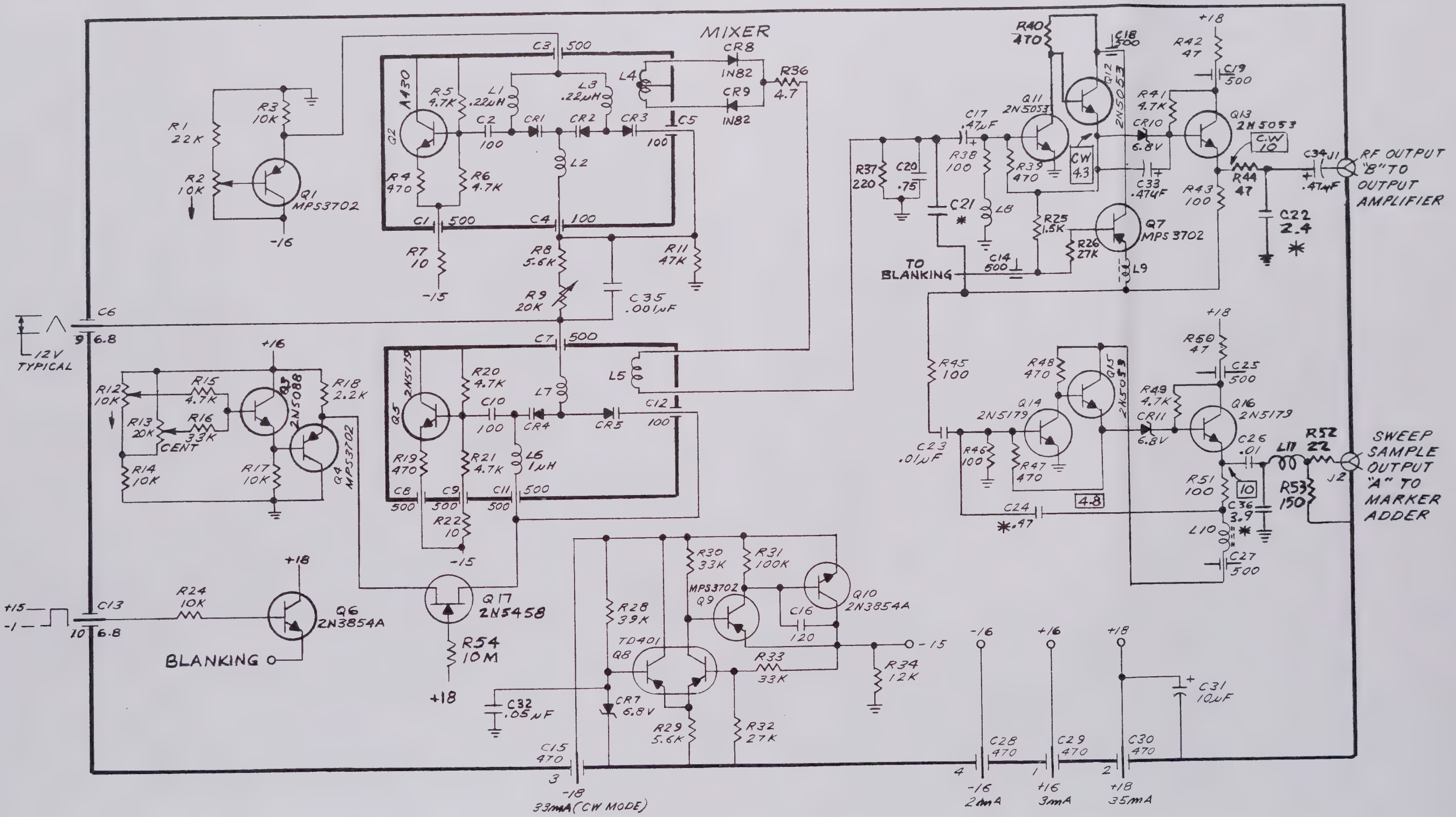
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2,3,17	Ceramic Feedthru, 6.8 pF ±10% 500 V	CF102-R68	A-B	FA5C	4
4	Ceramic Disc, 15 pF ±5% 1 kV	CD101-015	SPR	10TCC-Q15	1
5	Composition, 2.4 pF ±10% 500 V	CG101-224	Q-C	QC2.4	1
6	Ceramic Disc, .25 pF ±5% 1 kV	CD101-025	SPR	10TCC-Q25	1
7	Composition, 10 pF ±10% 500 V	CG101-310	Q-C	QC10	1
8,9,10,18, 19,20,21	Ceramic Feedthru, 470 pF ±20% 500 V	CF101-147	A-B	FA5C	7
11,14	Electrolytic, 10 µF 25 V	CE105-010	SPR	TE1204	2
12,15	Ceramic Disc, 470 pF ±20% 1 kV	CD102-147	SPR	5GAT47	2
13,16	Ceramic Disc, .01 µF ±20% 100 V	CD103-310	SPR	TGS10	2
22,23	Composition, 3.9 pF ±10% 500 V	CG101-239	Q-C	QC3.9	2
"CR "	DIODES				
1 to 17	Silicon, Junction 100 PTV 750 mA	DR000-001	DIO	1N4004	17
"R "	RESISTORS				
1,2	Metal Film, 178 Kilohm, matched set .1%	RX000-005	W-I	RX000-005	1
3	Composition, 2.2 Megohm ±5% ¼ W	RC103-522	A-B	CB2255	1
4,13,16,42, 44,46,55	Variable Cermet, 20 Kilohm ±10% 3/4 W	RP130-320	BEK	89PR20K	7
5	Composition, 470 Kilohm ±10% ¼ W	RC104-447	A-B	CB4741	1
6,17,18,19, 29,41,43, 45	Composition, 4.7 Kilohm ±10% ¼ W	RC104-247	A-B	CB4721	8
7,48,56	Composition, 8.2 Kilohm ±10% ¼ W	RC104-282	A-B	CB8221	3
8,30	Composition, 47 Kilohm ±10% ¼ W	RC104-347	A-B	CB4731	2
9,11	Composition, 100 ohm ±10% ¼ W	RC104-110	A-B	CB1011	2
10,14,32	Composition, 10 Kilohm ±10% ¼ W	RC104-310	A-B	CB1031	3
12	Composition, 82 Kilohm ±10% ¼ W	RC104-382	A-B	CB8231	1
15,47,59	Composition, 470 ohm ±10% ¼ W	RC104-147	A-B	CB4711	3
20,21,22,23	Composition, 2.2 Kilohm ±10% ¼ W	RC104-222	A-B	CB2221	4
24	Composition, 100 Kilohm ±10% ¼ W	RC104-410	A-B	CB1041	1
25,26,27,35, 39,40	Composition, 10 Megohm ±10% ¼ W	RC104-610	A-B	CB1061	6
28,33	Composition, 10 ohm ±10% ¼ W	RC104-010	A-B	CB1001	2
31	Composition, 27 Kilohm ±10% ¼ W	RC104-327	A-B	CB2731	1
34	Composition, 47 ohm ±10% ¼ W	RC104-047	A-B	CB4701	1
36,37,38	Composition, 18 Kilohm ±10% ¼ W	RC104-318	A-B	CB1831	3
49,60	Composition, 560 ohm ±10% ¼ W	RC104-156	A-B	CB5611	2
50,62	Composition, 4.7 ohm ±10% ¼ W	RC104-R47	A-B	CB47G1	2
51,61	Composition, 15 Kilohm ±10% ¼ W	RC104-315	A-B	CB1531	2
52,53	Metal Film, 10 Kilohm, matched set .1%	RX000-003	W-I	RX000-003	1
54	Composition, 1.2 Megohm ±10% ¼ W	RC104-512	A-B	CB1251	1
57	Metal Film, 21.5 Kilohm [matched set	RX000-004	W-I	RX000-004	1
58	Metal Film, 19 Kilohm [9:8 within .1%]				

PARTS LIST — MODULE M2J REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,14	NPN/NPN, Silicon Differential Amp	QB000-010	SPR	TD101	2
2,3,4,15	PNP, Silicon	QA042-500	FCD	2N4250	4
5,6,7,11,12, 13	P-channel, JFET	QA054-610	MOT	2N5461	6
8,17	PNP/PNP, Silicon Differential Amp	QB000-011	SPR	TD401	2
9,10,16,18	NPN, Silicon	QA050-880	MOT	2N5088	4
19	PNP, Silicon	QB000-009	MOT	MPS3702	1

OSCILLATOR-MIXER SCHEMATIC
MODULE M9G & M9H

REV H



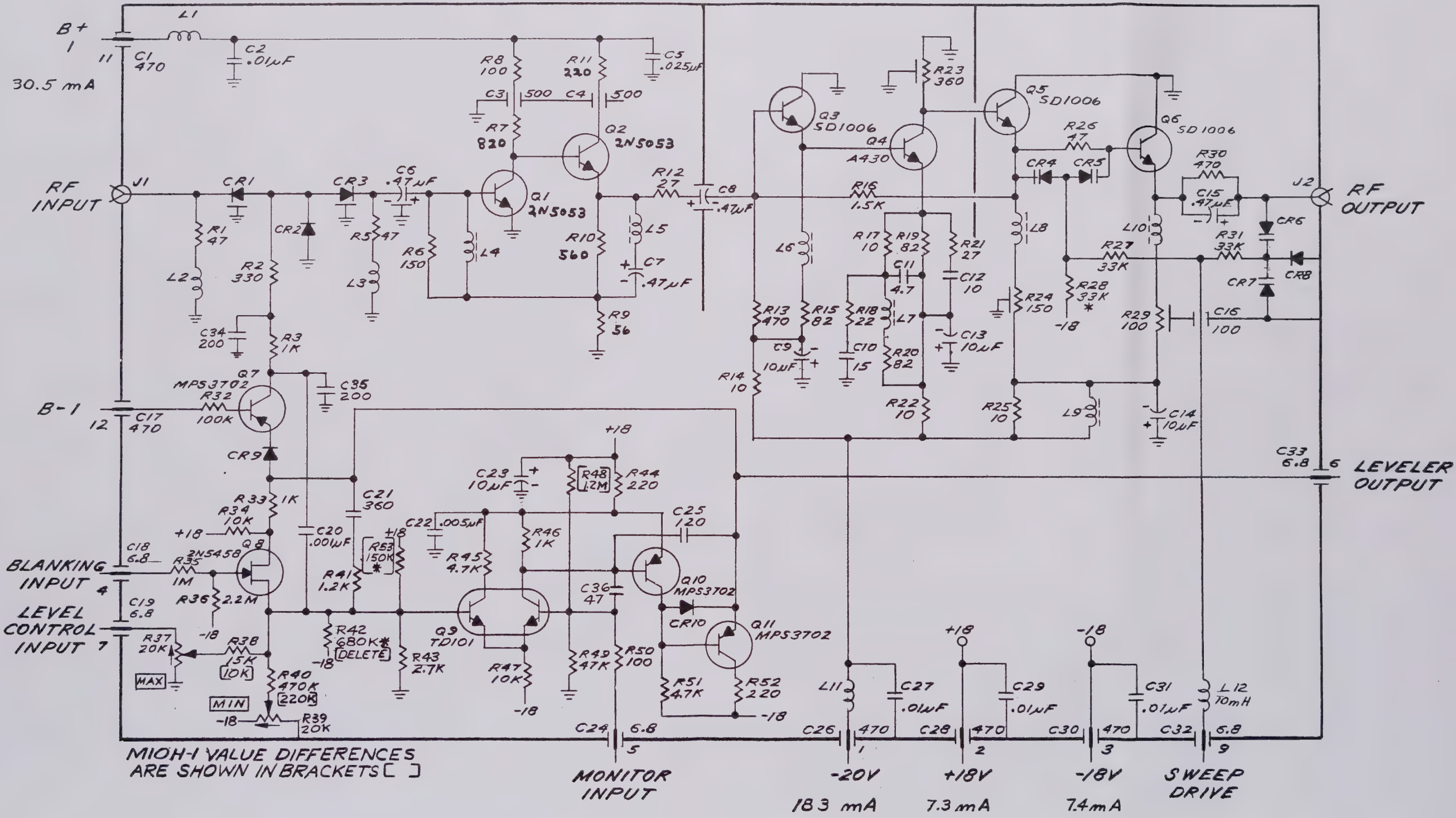
PARTS LIST — MODULE M9G M9H REV H

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,3,7,8,9, 11,14,18,19, 25,27	Ceramic Feedthru 500 pF ±20% 250 V	CF104-150	AER	EF4	11
2,10	Ceramic Disc, 100 pF ±10% 1 kV	CD108-110	RMC	C,N1500	2
5,12,4	Ceramic Feedthru, 100 pF ±20% 250 V	CF104-110	AER	EF4	3
6,13	Ceramic Feedthru, 6.8 pF ±10% 500 V	CF102-R68	A-B	FA5C	2
15,28,29,30	Ceramic Feedthru, 470 pF ±20% 500 V	CF101-147	A-B	FA5C	4
16	Ceramic Disc, 120 pF ±20% 1 kV	CD102-112	SPR	5GAT12	1
17,33,34	Electrolytic, .47 uF ±10% 50 V	CE113-447	TRW	935	3
20	Composition, .75 pF ±10% 500 V	CG101-175	Q-C	QC.75	1
21	Factory adjusted	Not Assign	---	------	--
22	Composition, 2.4 pF ±10%, factory adj.	CG101-224	Q-C	QC2.4	1
23,26	Ceramic Disc, .01 uF ±20% 100 V	CD103-310	SPR	TGS10	2
24	Factory adjusted, nominal value shown	Not Assign	---	------	--
31	Electrolytic, 10 uF 25 V	CE105-010	SPR	TE1204	1
32	Ceramic Disc, .05 uF ±20% 100 V	CD103-350	SPR	TGS50	1
35	Ceramic Disc, .001 uF ±20% 1 kV	CD102-210	SPR	5GAD10	1
36	Composition, 3.9 pF ±10%, factory adj.	CG101-239	Q-C	QC3.9	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50 ohm subminiature	JF000-005	APL	27-9	2
"CR "	DIODES				
1,2,3,4,5	Voltage variable capacitance	DC000-005	W-I	DC000-005	5
6	Not assigned	------	---	------	--
7,10,11	Zener, 6.8 V	DB000-001	C-L	ZD6.8A	3
8,9	Silicon, point contact (S-T only)	DG100-823	W-I	DG100-823	2
"L "	INDUCTORS				
1,3	Fixed, .22 uH	LA005-R02	ASE	08NR47K	2
2,7	Fixed -------	Not Assign	W-I	------	--
4	Fixed -------	Not Assign	W-I	------	--
5	Fixed -------	Not Assign	W-I	------	--
6	Fixed, 1 uH	LA005-R10	ASE	08N1R0K	1
8	Fixed -------	Not Assign	W-I	------	--
9,10	4 Turn Toroid	LA006-004	W-I	LA006-004	2
11	Fixed -------	Not Assign	W-I	------	1
"Q "	TRANSISTORS				
1,4,7,9	PNP, Silicon	QB000-009	MOT	MPS3702	4
2	NPN, Silicon, Wideband Amp.	QB000-013	APX	A430	1
3	NPN, Silicon, Low Noise	QA050-880	MOT	2N5088	1
5,14,16	NPN, Silicon	QA051-790	RCA	2N5179	3
6,10	NPN, Silicon,	QA038-541	G-E	2N3854A	2
8	PNP, Silicon, dual	QB000-011	SPR	TD401	1
11,12,13,15	NPN, Silicon	QA050-530	AMP	2N5053	4
17	N-Channel JFET	QA054-580	MOT	2N5458	1
"R "	RESISTORS				
1	Fixed Comp., 22 Kilohm ±10% ¼ W	RC104-322	A-B	CB2231	1
2,12	Variable Cermet, 10 Kilohm ±20%	RP129-310	CTS	360S103B	2
3,14,17,24	Fixed Comp., 10 Kilohm ±10% ¼ W	RC104-310	A-B	CB1031	4

PARTS LIST — MODULE M9G M9H REV H

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS (Cont'd)				
4,19,39,40, 47,48	Fixed Comp., 470 ohm ±10% ¼ W	RC104-147	A-B	CB4711	6
5,6,15,20,21 41,49	Fixed Comp., 4.7 Kilohm ±10% ¼ W	RC104-247	A-B	CB4721	7
7,22	Fixed Comp., 10 ohm ±10% ¼ W	RC104-010	A-B	CB1001	2
8,29	Fixed Comp., 5.6 Kilohm ±10% ¼ W	RC104-256	A-B	CB5621	2
9	Variable Cermet, 20 Kilohm ±10%	RP129-320	CTS	360S203B	1
10,23,27,35	Not Assigned	---------	---	--------	--
11	Fixed Comp., 47 Kilohm ±10% ¼ W	RC104-347	A-B	CB4731	1
13	Variable Carbon, 20 Kilohm ±20%	RP124-320	A-B	WA2G032	1
16,30	Fixed Comp., 33 Kilohm ±10% ¼ W	RC104-333	A-B	CB3331	2
18	Fixed Comp., 2.2 Kilohm ±10% ¼ W	RC104-222	A-B	CB2221	1
25	Fixed Comp., 1.5 Kilohm ±10% ¼ W	RC104-215	A-B	CB1521	1
26	Fixed Comp., 27 Kilohm ±10% ¼ W	RC104-327	A-B	CB2731	1
28	Fixed Comp., 39 Kilohm ±10% ¼ W	RC104-339	A-B	CB3931	1
31	Fixed Comp., 100 Kilohm ±10% ¼ W	RC104-410	A-B	CB1041	1
32	Fixed Comp., 27 Kilohm ±5% ¼ W	RC103-327	A-B	CB2735	1
33	Fixed Comp., 33 Kilohm ±5% ¼ W	RC103-333	A-B	CB3335	1
34	Fixed Comp., 12 Kilohm ±10% ¼ W	RC104-312	A-B	CB1231	1
36	Fixed Comp., 4.7 ohm ±10% ¼ W	RC104-R47	A-B	CB47G1	1
37	Fixed Comp., 390 ohm ±10% ¼ W	RC104-139	A-B	CB3911	1
38,43,45,46, 51	Fixed Comp., 100 ohm ±10% ¼ W	RC104-110	A-B	CB1011	5
42,44,50	Fixed Comp., 47 ohm ±10% ¼ W	RC104-047	A-B	CB4701	3
52	Fixed Comp, 22 ohm ±10% ¼ W	RC104-022	A-B	CB2201	1
53	Fixed Comp., 150 ohm ±10% ¼ W	RC104-115	A-B	CB1511	1
54	Fixed Comp., 10 Megohm ±10% ¼ W	RC104-610	A-B	CB1061	1

OUTPUT AMPLIFIER SCHEMATIC
MODULE MIOH & MIOH-1
REV F



MIOH-1 VALUE DIFFERENCES ARE SHOWN IN BRACKETS [ ]

PARTS LIST — MODULE M10H / M10H-1 REV G

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,17,26,28, 30	Ceramic Feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	5
2,27,29,31	Ceramic Disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	4
3,4	Ceramic Feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	2
5	Ceramic Disc, .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
6,7,8,15	Electrolytic, .47uF 50V	CE113-447	TRW	935	4
9,13,14,23	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	4
10	Ceramic Disc, 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
11	Ceramic Disc, 4.7pF ±5% 1kV	CD101-R47	SPR	10TCC-V47	1
12	Ceramic Disc, 10pF ±5% 1kV	CD101-010	SPR	10TCC-Q10	1
16	Ceramic Feedthru, 100pF ±20% 250V	CF104-110	AER	EF4	1
18,19,24,32, 33	Ceramic Feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
20	Ceramic Disc, .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	1
21	Ceramic Disc, 360pF ±20% 1kV	CD102-136	SPR	5GA-T36	1
22	Ceramic Disc, .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
25	Ceramic Disc, 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
34,35	Ceramic Disc, 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	2
36	Ceramic Disc, 47pF ±5% 1kV	CD104-047	SPR	10TCU-Q47	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50 ohm submin.	JF000-005	APL	27-9	2
"CR "	DIODES				
1,2,3	Silicon, P.I.N.	DP000-050	H-P	5082-3080	3
4,5,6,7	Voltage variable capacitance	DC000-008	W-I	DC000-008	4
8	Silicon, Hot Carrier	DG000-007	H-P	5082-2800	1
9,10	Silicon, Junction, 100piV 750mA	DR000-001	DIO	1N4004	2
"L "	INDUCTORS				
1,4,5,9,11	10 Turn Toroid	LA006-010	W-I	LA006-010	5
2,3	Fixed,-------	Not Assign	W-I	---------	-
6,7,8,10	4 Turn Toroid	LA006-004	W-I	LA006-004	4
12	Fixed, 10mH	LA004-310	ASE	15S103K	1
"R "	RESISTORS				
1,5,26	Fixed Comp., 47 ohm ±10% ¼W	RC104-047	A-B	CB4701	3
2	Fixed Comp., 330 ohm ±10% ¼W	RC104-133	A-B	CB3311	1
3,33,46	Fixed Comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	3
4	Not Assigned	----------	---	------	-
6	Fixed Comp., 150 ohm ±10% ¼W	RC104-115	A-B	CB1511	1
7	Fixed Comp., 820 ohm ±10% ¼W	RC104-182	A-B	CB8211	1
8,50	Fixed Comp., 100 ohm ±10% ¼W	RC104-110	A-B	CB1011	2
9	Fixed Comp., 56 ohm ±10% ¼W	RC104-056	A-B	CB5601	1
10	Fixed Comp., 560 ohm ±10% ¼W	RC104-156	A-B	CB5611	1
11,44,52	Fixed Comp., 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	3
12,21	Fixed Comp., 27 ohm ±10% ¼W	RC104-027	A-B	CB2701	2
13	Fixed Comp., 470 ohm ±5% ¼W	RC103-147	A-B	CB4715	1
14,17,22,25	Fixed Comp., 10 ohm ±5% ¼W	RC103-010	A-B	CB1005	4
15,19,20	Fixed Comp., 82 ohm ±5% ¼W	RC103-082	A-B	CB8205	3
16	Fixed Comp., 1.5k ohm ±5% ¼W	RC103-215	A-B	CB1525	1

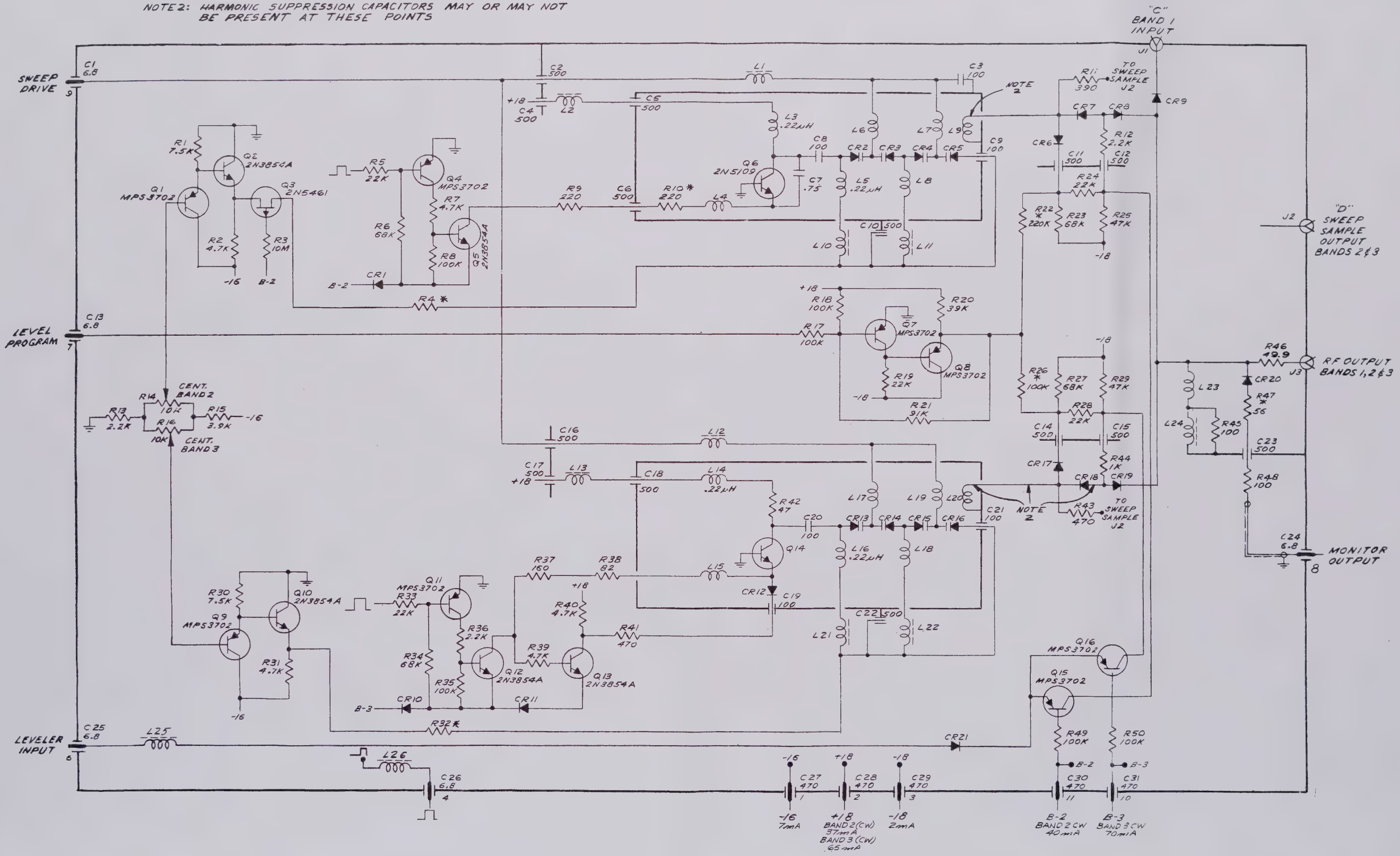
PARTS LIST — MODULE M10H / M10H-1REV G

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
18	Fixed Comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	1
23	Fixed Comp., 360 ohm ±5% ½W A-B only	RC105-136	A-B	EB3615	1
24	Fixed Comp., 150 ohm ±5% 1W	RC107-115	A-B	GB1515	1
27,28,31	Fixed Comp., 33k ohm ±10% ¼W	RC104-333	A-B	CB3331	3
29	Fixed Comp., 100 ohm ±5% 1W	RC107-110	A-B	GB1015	1
30	Fixed Comp., 470 ohm ±10% ¼W	RC104-147	A-B	CB4711	1
32	Fixed Comp., 100k ohm ±10% ¼W	RC104-410	A-B	CB1041	1
34,(38),47	Fixed Comp., 10K ohm ±10% ¼W	RC104-310	A-B	CB1031	3
35	Fixed Comp., 1M ohm ±10% ¼W	RC104-510	A-B	CB1051	1
36	Fixed Comp., 2.2M ohm ±10% ¼W	RC104-522	A-B	CB2251	1
37,39	Variable, carbon 20k ohm ±20% ¼W	RP124-320	A-B	WA2G032	2
38	Fixed Comp., 15k ohm ±10% ¼W	RC104-315	A-B	CB1531	1
40	Fixed Comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	1
(40)	Fixed Comp., 220k ohm ±10% ¼W	RC104-422	A-B	CB2241	1
41	Fixed Comp., 1.2k ohm ±10% ¼W	RC104-212	A-B	CB1221	1
42	Fixed Comp., 680k ohm ±10% ¼W	RC104-468	A-B	CB6841	1
43	Fixed Comp., 2.7k ohm ±10% ¼W	RC104-227	A-B	CB2721	1
45,51	Fixed Comp., 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	2
(48)	Fixed Comp., 1.2M ohm ±10% ¼W	RC104-512	A-B	CB1251	1
49	Fixed Comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	1
53	Fixed Comp., 150k ohm ±10% ¼W	RC104-415	A-B	CB1541	1
"Q "	TRANSISTORS				
1,2	NPN, Silicon	QA050-530	AMP	2N5053	2
3,5,6	NPN, Silicon	QB000-018	SSS	SD1006	3
4	NPN, Silicon	QB000-013	APX	A430	1
7,10,11	PNP, Silicon	QB000-009	MOT	MPS3702	3
8	N-channel JFET, Silicon	QA054-580	MOT	2N5458	1
9	PNP, Silicon, dual	QB000-010	SPR	TD101	1

SWEEP OSCILLATOR SCHEMATIC
BAND 2 & 3
MODULE M19H
"A" VERSION (SEE NOTE 1) REV G

NOTE 1: "A" VERSION = CHANGES OUTPUT IMPEDANCE TO 75Ω
PARTS AFFECTED ARE R46, R47, & J3 (SEE PARTS LIST)

NOTE 2: HARMONIC SUPPRESSION CAPACITORS MAY OR MAY NOT BE PRESENT AT THESE POINTS



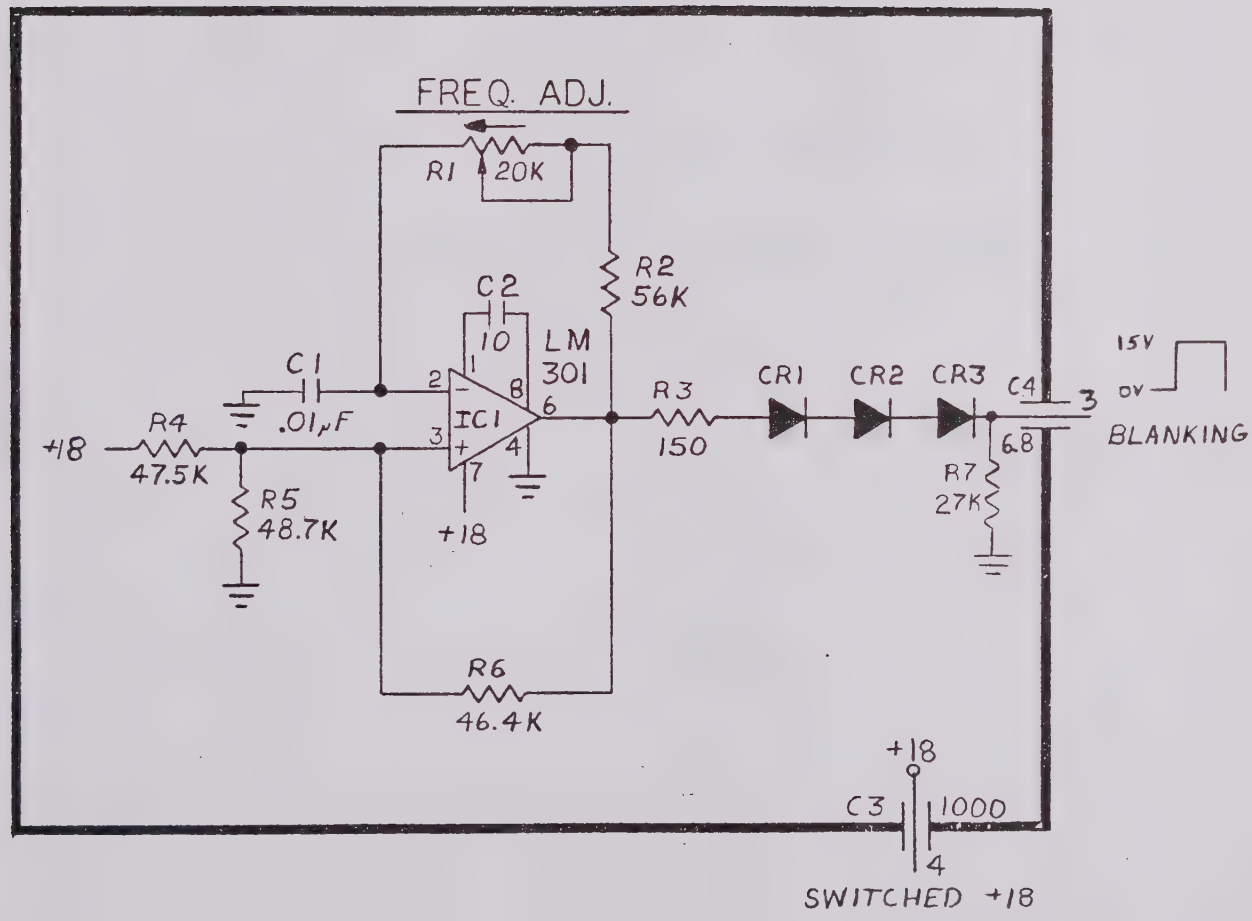
PARTS LIST — MODULE M19H REV G

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,13,24,25 26	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
2,4,5,6,10 11,12,14, 15,16,17,18 22,23	Ceramic feedthru 500pF ±20% 250V	CF104-150	AER	EF4	14
3,8,9,19,20, 21	Ceramic feedthru 100pF ±20% 250V	CF104-110	AER	EF4	6
7	Composition .75pF ±10% 500V	CG101-175	Q-C	QC.75	1
27,28,29,30 31	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	5
Note 2	Composition, from .2pF to 1pF	CG102----	Q-C	QC	--
"J "	CONNECTORS				
1,2,3	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	3
"CR "	DIODES				
1,10,11,21	Silicon, Junction 100piV, 750mA	DR000-001	DIO	1N4004	4
2,3,4,5,13 14,15,16	Voltage variable capacitance	DC000-008	W-I	DC000-008	8
6,7,8,9,12 17,18,19	Silicon, P.I.N.	DP000-040	W-I	DP000-040	8
20	Silicon, point contact	DG100-821	G-I	1N82AS	1
"L "	INDUCTORS				
1,2,10,11,12 13,21,22	4 Turn Toriod	LA006-004	W-I	LA006-004	8
3,5,14,16	Fixed, .22uH	LA005-R02	ASE	08NR47K	4
4,7,8,15 17,18,19	Fixed, -----	Not assign.	W-I	Not assign.	--
6	Fixed, -----	Not assign.	W-I	Not assign.	--
9,20	Fixed, -----	Not assign.	W-I	Not assign.	--
23	Fixed, -----	Not assign.	W-I	Not assign.	--
24	10 Turn Toroid	LA006-010	W-I	LA006-010	1
25,26	4 Turn Toroid	LA007-004	W-I	LA007-004	2
"R "	RESISTORS				
1,30	Fixed, comp. 7.5kohm ±5% ¼W	RC103-275	A-B	CB7525	2
2,7,31,39 40	Fixed, comp. 4.7kohm ±10% ¼W	RC104-247	A-B	CB4721	5
3	Fixed, comp. 10Mohm ±10% ¼W	RC104-610	A-B	CB1061	1
4,22,26	Fixed, adjustable, nominal value shown	RC104----	---	------	-
5,19,24,28 33	Fixed, comp. 22kohm ±10% ¼W	RC104-322	A-B	CB2231	5
6,23,27,34	Fixed, comp. 68kohm ±10% ¼W	RC104-368	A-B	CB6831	4
8,17,18,35 49,50	Fixed, comp. 100kohm ±10% ¼W	RC104-410	A-B	CB1041	6
9,10*	Fixed, comp. 220ohm ±10% ½W	RC106-122	A-B	EB2211	2
11	Fixed, comp. 390ohm ±10% ¼W	RC104-139	A-B	CB3911	1
12,13,36	Fixed, comp. 2.2kohm ±10% ¼W	RC104-222	A-B	CB2221	3
14,16	Variable, wire wound 10kohm	RV102-310	BOU	3067P	2
15	Fixed, comp. 3.9kohm ±10% ¼W	RC104-239	A-B	CB3921	1
20	Fixed, comp. 39kohm ±10% ¼W	RC104-339	A-B	CB3931	1

PARTS LIST — MODULE M19H REV G

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
21	Fixed, comp. 91kohm ±5% ¼W	RC103-391	A-B	CB9135	1
25,29	Fixed, comp. 47kohm ±10% ¼W	RC104-347	A-B	CB4731	2
32*	Fixed, comp. 6.8kohm ±10% ¼ W	RC104-268	A-B	CB6821	1
37	Fixed, comp. 160ohm ±5% 1W	RC107-116	A-B	GB1615	1
38	Fixed, comp. 82ohm ±10% ½W	RC106-082	A-B	EB8201	1
41	Fixed, comp. 470ohm ±10% 1W	RC108-147	A-B	GB4711	1
42	Fixed, comp. 47ohm ±10% ¼W	RC104-047	A-B	CB4701	1
43	Fixed, comp. 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
44	Fixed, comp. 1kohm ±10% ¼W	RC104-210	A-B	CB1021	1
45,48	Fixed, comp. 100ohm ±10% ¼W	RC104-110	A-B	CB1011	2
46	Metal Film, 49.9 ohm ±1%	RF404-990	E-M	MF5C1%TO	1
47	Fixed, comp. 56ohm ±10% ¼W	RC104-056	A-B	CB5601	1
"Q "	TRANSISTORS				
1,4,7,8,9, 11,15,16	NPN, Silicon	QB000-009	MOT	MPS3702	8
2,5,10,12,13	NPN, Silicon	QA038-541	G-E	2N3854A	5
3	P-channel JFET	QA054-610	MOT	2N5461	1
6	NPN, Silicon	QA051-090	SSS	2N5109	1
14	NPN, Silicon	QB000-015	W-I	QB000-015	1
	PARTS SUBSTITUTED FOR M19HA (75 ohm Module)				
"J "	CONNECTORS (JACKS)				
3	Jack, 75 ohm subminiature	JF000-004	APL	27-21	1
"R "	RESISTORS				
46	Metal Film, 75 ohm ±1%	RF407-500	E-M	MF5C1%TO	1
47*	Composition, 75 ohm ±10% ¼ W	RC104-075	A-B	CB7501	1

M6Z-1
1KHZ MODULATOR



REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C1	CAP,FILM,10KPF,160V CP105-310	SXM110	MAL	1510-60-5103	1
C2	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	1
C3	CAP,CER,F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	1
C4	CAP,F.T.,6.8PF CF102-R68	FASC-6892	A-H	1510-30-1689	1
CR1 CR2 CR3	DIODE DG109-140	1N4148	FCD	4807-01-0914	3
IC1	IC,8 PIN,IC000-008	LM301-AN	NAT	7000-03-0100	1
R1	POT,20K RP124-320	WA2G0328-203MA	A-B	4610-10-7203	1
R2	RES,C,1/4W,5%,56K RC103-356	CF1/4-56K	ASE	4700-15-5602	1
R3	RES,C,1/4W,5%,150 RC103-115	CF1/4-150	ASE	4700-15-1500	1
R4	RES,MF,1/8W,1%,47.5K RF213-475	MF55K-47.5K	ASE	4701-03-4752	1
R5	RES,MF,1/8W,1%,48.7K RF213-487	MF55K-48.7K	ASE	4701-03-4872	1
R6	RES,MF,1/8W,1%,46.4K RF213-464	MF55K-46.4K	ASE	4701-03-4642	1

WAVETEK PARTS LIST	TITLE 1 KHZ SQR WAVE MODULATOR, M6Z-1	ASSEMBLY NO. 1114-00-0150 PAGE: 1	REV A

MODELS 2000 AND 2001A/B MANUAL CHANGES

WAVETEK'S product improvement program incorporates the latest electronic developments into these instruments as rapidly as development and testing permit. Due to the time required to document and print these instruction manuals, it is not always possible to include the change information in the current printing. The following changes should be made to this manual:

1. The use of ball studs on certain modules has been discontinued. In place of ball studs, a single index stud and a #6 screw is used. The index stud is located on the module end nearest pin #1.

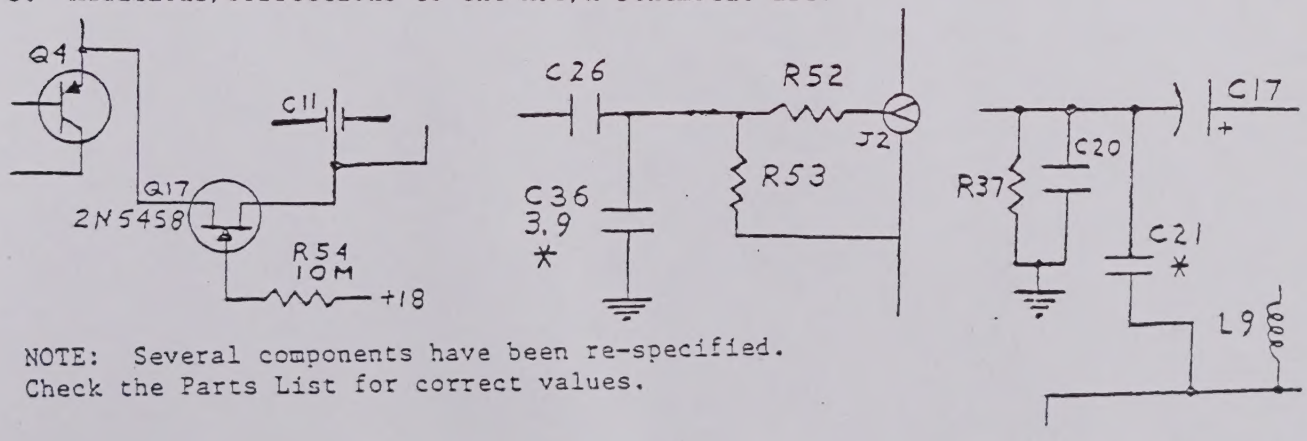
Modules without ball studs but with index studs may be used in any chassis with no mismatch of pins, and they cannot be plugged in backwards.

2. The M9G/H Parts List should have the following additions/corrections made:

"C"	CAPACITORS			
22	Composition, 2.4 pF ±10%, factory adj.	CG101-224	Q-C	QC2.4
36	Composition, 3.9 pF ±10%, factory adj.	CG101-239	Q-C	QC3.9

"Q"	TRANSISTORS			
1,4, 7,9	PNP, Silicon	QB000-009	MOT	MPS3702
2	NPN, Silicon, Wideband Amp.	QB000-013	APX	A430
3	PNP, Silicon, Low noise	QA050-880	MOT	2N5088
5,14, 16	NPN, Silicon	QA051-790	RCA	2N5179
6,10	NPN, Silicon	QA038-541	G-E	2N3854A
8	PNP, Silicon, Dual	QB000-011	SPR	TD401
11,12, 13,15	NPN, Silicon	QA050-530	AMP	2N5053
17	N-channel JFET	QA054-580	MOT	2N5458

3. Additions/Corrections to the M9G/H schematic are:



NOTE: Several components have been re-specified. Check the Parts List for correct values.

MP MASTER
MA34160